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Volume 10 - Number 3

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Volume 10 July-September Number 3

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TENTH WORLD'S POULTRY CONGRESS A SUCCESS

The Tenth World's Poultry Congress held at Edinburgh, Scotland, August 13 to 21 was acclaimed a success and thus joins its predecessors in making a definite contribution to the advance of the world's poultry industry.

This Congress further strengthened the aims as developed at the previous World's Poultry Congresses. These aims as expressed many times in the past are to promote friendly relationship among all people interested in poultry farming and to encourage international contacts, to stimulate scientific research and the instruction of poultry farming by means of reports, discussions and expositions, to encourage production, commerce and consumption of poultry products on a national and international level, to spread throughout the whole world the interest poultry farming represents and to attract the attention of all those interested in breeding to the most modern and rational methods used in different countries of the world, and to afford poultry keepers from all parts of the world an opportunity to visit some poultry farms and other units of the industry, and places of historical and scenic interest.

The Congress had official representation representing 58 countries with nine other countries listed as associates. These countries were represented by 147 official delegates, 1,169 registered members, 488 wives and relatives of members, and 260 associate members. At the time of the opening of the Congress the list of members included representatives from the following countries: Australia, Basutoland, Bechuanaland and Zwaziland, Belgian Congo, Belgium, Canada, Ceylon, Cyprus, Denmark, Egypt, Eire, England, Finland, France, Germany, Iceland, Israeli, Italy, Jamaica, Japan, Lebanon, Malaya, Malta, Netherlands, Nigeria, Northern Ireland, Norway, Pakistan, Philippine Islands, Portugal, Scotland, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Uganda, United States of America, Wales.

The meetings of the Congress were appropriately held in the historic and magnificent buildings of the University of Edinburgh. Impressive opening and closing sessions were held in McEwan Hall. The Congress was officially opened by Her Royal Highness, Princess Alice, Countess of Athlone.

The mornings were devoted to the principal business of the Congress, namely the scientific sessions. These opened with

a plenary session with three distinguished scientists giving review developments in genetics, nutrition and disease control. On the other days, the sessions were divided into five sections with papers listed as follows: Genetics and Breeding, 28; Physiology and Nutrition, 30; Diseases and Their Control, 28; Economics and Marketing, 9; Husbandry and Miscellaneous, 16. These papers were submitted by poultry experts from 23 countries. The sectional sessions were held in the Old College, Edinburgh University. Films of scientific interest were also shown at two special sessions.

A poultry Congress exhibition was also held in the Waverly Market. This exhibition was designed to show to members of the Congress and to the general public some of the best features of poultry keeping as practiced in Scotland. All of the breeds of Scotland were displayed in an attractive setting. The various phases in the production and marketing of chickens and turkeys were portrayed. Exhibits of equipment, appliances, feeding stuffs and other poultry requirements by leading manufacturers were also included. A special feature of the exhibition was a series of daily demonstrations on the preparation of eggs and poultry for the table which was listed as "Chicken in the Kitchen". These were designed particularly to interest the general public and especially the housewife with demonstrations of trussing, cooking and carving. The final rounds of poultry judging and trussing competition sponsored by the Scottish Association of Young Farmers Clubs were also staged at the exhibition.

Another exhibition featuring education and research was held at the Royal Scottish Museum. In this exhibition the Scottish Agricultural Colleges and Research Institutes cooperated in demonstrating the education, advisory and research work in Scotland.

The afternoons were devoted chiefly to becoming acquainted with Edinburgh and its surroundings. There were included visits to factories, glassworks, nurseries, poultry farms and laboratories, and places of historical interest. A special program of entertainment including a visit to historic Glamis Castle, was also arranged for the ladies.

Social activities were not overlooked. One of the important benefits of the World's Poultry Congress is to become better acquainted with and to have a fuller understanding of fellow workers from other lands. The program of hospitality and entertainment included an official reception held in his-

toric Parliament Hall, a Civic Garden Party Reception, and an official dinner for leading members of the various delegations. It also included an evening visit to a spectacular show at Edinburgh's large new ice rink, a Scottish Evening with highland and country dancing at the Congress Social Club, and a visit to Edinburgh Castle for a special performance of the Military Tattoo which has been such an attractive feature of the annual Edinburgh Festival. Edinburgh Corporation, the University of Edinburgh, the Company of Edinburgh Merchants and many others offered kind hospitality to those taking part in the Congress.

A new and very worthwhile feature of the Tenth World's Poultry Congress was the Congress Club. This consisted of the use of the official club of the Edinburgh Festival Society consisting of a magnificent suite of rooms providing for meals and dancing. This club served as headquarters and the social center for the members of the Congress.

The World's Poultry Science Association, the organization which sponsors the Congresses, also had a successful triennial meeting with a large number of its members present. There was a general feeling that this organization is and should be the leader in promoting the welfare of the poultry industry of the world. A number of resolutions were adopted at the meeting, and presented at the closing session on behalf of all of the members of the Congress.

In order to enable the guests from abroad to become more familiar with Scottish agriculture, as well as places of scenic and historic interest, several pre-Congress trips were arranged. These gave the participants opportunity to gain firsthand information and observation regarding poultry breeding farms and educational and industrial institutions. These tours took the members to the Highlands, Central Scotland and the Borders.

As in the past, this Congress has again demonstrated the fact that with a common interest, such as poultry, and with a desire to understand each other there can be international peace and understanding.

G. F. Heuser

MEETING OF THE COUNCIL OF THE WORLD'S POULTRY SCIENCE ASSOCIATION

A meeting of the Council of the World's Poultry Science Association was held in the North British Hotel, Princes Street, Edinburgh at 8 p.m. on Sunday, 15th August, 1954. The following members were present:

Mr. Alex Wiltzer (France), President (Chairman); Mr. W. A. Kock (Denmark), and Professor A. Ghigi (Italy), Hon. Past Presidents: Dr. R. Coles (England), Dr. H. Engler (Switzerland), Mr. J. W. Kinghorne (U.S.A.), Dr. F. Lievens (Belgium), and Mr. C. S. Th. Van Gink, (The Netherlands), Vice-Presidents; Mr. S. Trainor (Australia), Prof. R. Willems, (Belgium), Dr. H. S. Gutteridge, (Canada), Mr. J. Traberg (Denmark), Mr. D. Philpott (Eire), Dr. R. F. Gordon, Mr. E. T. Halnan, Dr. C. Horton-Smith, Dr. S. K. Kon, Mr. K. Wilson (England), Prof. N. Westermarck, (Finland), Dr. A. von Burgsdorff-Garath (Germany), Prof. L. de Blieck, Mr. J. D. Tukker (Netherlands), Mr. J. G. Rhynehart, (Northern Ireland), Miss M. M. MacLeod, Mr. J. E. Wilson (Scotland), Mr. G. Hibbert (South Africa), Mr. E. Haeggblom (Sweden), Mr. H. Ebbell (Switzerland), Mr. H. H. Alp, Dr. R. J. G. Jaap, Dr. O. B. Kent, Mr. M. C. Small (U.S.A.), Dr. G. F. Heuser (U.S.A.), Treasurer and Assistant Secretary and Major Ian Macdougall (England), Secretary and Assistant Treasurer.

(Attendance 34, representing 17 countries).

Apologies for non-attendance were received from Mr. J. van Ingelgem (Belgium), Dr. D. J. G. Black, W. Marshall (England), Prof. J. R. Cavers, Mr. G. L. Landon, (Canada), Prof. G. Lesbouyries (France), Mr. Nurul Islam (Pakistan), Mr. L. Lattore (Spain), and Mr. W. D. Termohlen (U.S.A.).

In submitting the apologies, the Secretary informed the meeting that the absence of Mr. Termohlen was, unfortunately, due to the serious illness of Mrs. Termohlen and that he had anticipated the wishes of the members and sent a cablegram to Mr. Termohlen expressing their regret at his inability to be present, at the reason for his absence and conveying their wishes for Mrs. Termohlen's speedy recovery. The Secretary's action was heartily approved.

MINUTES

The Minutes of the meeting held on 4th August, 1951, having been circulated, were confirmed and signed.

SECRETARY'S REPORT

A report (attached) covering the period from August, 1951 to 30th June, 1954, was presented by the Secretary and unanimously approved.

TREASURER'S REPORT

Statements of Receipts and Expenditure for the period 1st January to 30th June, 1954, duly audited, reflecting credit balances of $3824.56 and £1,691-4-7 were submitted by the Treasurer and the Assistant Treasurer. It was reported that there was a credit balance of $10,679.57 at the Savings Account. The Statements were unanimously approved.

PRESIDENT'S REPORT

In submitting his report the President very strongly emphasized the urgent necessity for increasing the membership of the Association. He pointed out that the Association enjoyed considerable prestige throughout the world and that Congresses were the living example and demonstration of that prestige. All poultry-keepers should belong to the Association. He recognized that the language problem presented difficulties but pointed out that increased membership would ensure additional income, additional income would ensure an extension of the Association's activities and would enable them to give consideration to the question of publishing the World's Poultry Science Journal in other languages. He thanked all the members who had been responsible for enlisting new members, hoped they would continue their good work and that others would follow their praiseworthy efforts. He appealed to all members to give the greatest possible publicity to the Association's aims and objects and added that if all members played their parts, an increased membership could easily be obtained and maintained.

He thanked the Secretary and Treasurer for the splendid work they had done and were doing in the interests of the Association and its members.

THE WORLD'S POULTRY SCIENCE JOURNAL

The Editor, in his Report, drew attention to the fact that in 1946, 1,000 copies of each issue were printed. That number had been steadily increased and 1950 copies of the April-June 1954 issue were printed. The mailing list for that number was as follows: 10 patrons, 135 affiliations, 1361 individual members, 93 libraries, 82 subscriptions and 55 exchanges and complimentary.

The President thanked Dr. Heuser, not only for his report but also for his activities and efforts as editor of the Journal. He stressed the importance of the Journal from the educational aspect and pointed out that it was the only means of contact between Congresses. He felt that the Association could congratulate itself on the excellence of the Journal, the credit for which should go to Dr. Hauser. He thanked all those who had helped in its publication.

In reply to a question from a member who thought that more frequent issues of the Journal were necessary, as to whether the inability to bring out additional issues was due to a lack of finance or a lack of collaboration, Dr. Heuser said is due to a lack of material. If more material were available they could have a larger Journal but that envisaged additional expenditure. However their balances had been increasing and some of that could have been alloted to the Journal. Another member pointed out that considerable help could be given by the formation of additional Branches.

As there appeared to be some confusion in regard to the functions of the Publication Committee, Dr. Gutteridge, Chairman, took the opportunity of clarifying the position. He pointed out that members were not expected, as some people apparently thought, to submit articles themselves, although they could do so if they wished. Their duty was to collect material from their respective countries for the Journal and to keep in touch regularly with himself or the Editor. Later on he would be suggesting that the number of members on the Publication Committee should be increased as he felt that sufficient countries were not represented.

(b) A resolution was submitted from Mr. Latorre (Spain) suggesting that consideration might be given to the publication of the Journal in Spanish, as it was felt if that were done a very considerable number of new members could be secured in Spain and Ibero-America, and that the additional income thereby secured would be sufficient to meet the additional cost involved. During the discussion suggestions were put forward for publication in other languages. The Secretary pointed out that in considering the matter, the question of the considerable additional financial expenditure which would be involved should not be overlooked. It was decided that the matter should be referred to the Publication Committee who were asked to work in close conjunction with the Secretary and Treasurer.

(c) A resolution was submitted from the Swiss Branch who, while paying tribute to the value and usefulness of the "Review of Poultry Publications" published in the Journal, suggested that the scope of the Review, which at present dealt principally with publications appearing in the United States and Canada, should be extended.

In countries with approved Branch Organizations these Branches could be asked to designate or propose one or more experts who would be capable and prepared to sift the relative publications of their country and to do the necessary abstracting work in English. In countries without such a Branch Organization but with a highly-developed Poultry Industry, inquiries should be made from competent authorities or organizations who could suggest qualified specialists willing to abstract interesting publications and translate them into English. It should also be considered how persons undertaking this work should be compensated by the W.P.S.A.

Mr. Kinghorne (U.S.A.) who edits the Review said he was perfectly agreeable to using any service which was made available to him. If the Association would subscribe to the cost of the biological extracts which were published he would review them. In view of the fact that Mr. Kinghorne is a member of the Publication Committee, it was agreed to refer the matter to that Committee where he would expand upon it.

FOOD AND AGRICULTURE ORGANIZATION

Consideration was given to the advisability of an application being submitted to the Food and Agriculture Organization for "specialized consultative status." At the request of the Secretary, a memorandum embodying particulars of the "status" had been sent to members of the Council by Dr. H. Engler. It was pointed out that F.A.O. collects analyses, interprets and disseminates information relating to nutrition, food and agriculture. It also promotes and recommends action with respect to (a) research; (b) the improvement of education and the spread of nutritional and agricultural science and practice; (c) the conservation of natural resources and the adoption of improved methods of agricultural production; (d) the improvement of processing, marketing and distribution of food and agricultural products.

It was eventually decided by 15 votes to 4 that an application should be submitted for "specialized consultative status."

EGG GRADES COMMITTEE

The Secretary stated that a report of a meeting held at Geneva of a Committee of the Economic Commission for Europe which was considering proposals for the commercial standardization of hen eggs in shell moving in international trade had been circulated to members of the Council for their information. He reported that a meeting of the Egg Grades Committee was being held during Congress and that it was hoped to present a report of that meeting at the Association's Triennial Meeting.

FELLOWSHIPS

A suggestion was submitted from Mr. R. M. Hanson (U.S.A.) that a foundation, to which monies could be given or willed by estates and trusts, should be established. The purpose of the foundation would be to provide fellowships for outstanding individuals in member nations that are worthy but unable to attend World's Poultry Congresses. The foundation would allot fellowships in amounts sufficient to cover transportation, lodging and registration during a congress and post congress tour. Members of Council would constitute a Board to make the appointments. The suggestion was accepted in principle and it was left to the Association's officials to examine how such a foundation could be established.

BRANCH ORGANIZATION

The establishment of a Branch in Japan and its rules were approved.

AFFILIATIONS

Consideration was given to a suggestion submitted by Dr. O. B. Kent (U.S.A.) that, on the occasion of the holding of Congresses, Associated Membership of Congress might be granted to all affiliated memberships by the Association. In reply to a question the Treasurer stated that at the present Congress the amount involved would be between $800-900. It was agreed that such membership should be granted free to Patrons and Affiliations on request.

TECHNICAL DICTIONARY

The Secretary reported that, following upon the recommendation of the Triennial meeting of the Association held in Paris in 1951, that a dictionary of technical terms used in poultry should be prepared and that the Council should appoint a special Committee to deal with the matter, a circular had been sent to all members of Council inviting their sugges-

tions in regard to the implementation of the recommendation and names of suitable persons for appointment to the suggested Committee. In view of the diverse nature of the replies and the anxiety expressed by members in regard to the financial expenditure involved, he had, after consultation with the President, decided to defer any further action and refer the question back to the present meeting. After discussion, it was agreed that the President, Professor Doctor de Blieck and the Secretary should approach people technically able to assist in the preparation of such a dictionary.

EGG PRODUCTION

A recommendation from Mr. N. Islam (Pakistan) suggesting that the Association should suggest to Governments the desirability of introducing legislation to limit the slaughter of female fowls was allowed to lie on the table.

LAYING TRIALS COMMITTEE

It was reported that a meeting of the Laying Trials Committee was being held during the Congress and a report of the meeting would be submitted at the Triennial meeting of the Association.

in the meantime, members were reminded that the first report of the Committee appeared in the World's Poultry Science Journal, Vol. 6, No. 4, Oct.-Dec., 1950, pp. 292-297.

WORLD'S POULTRY CONGRESS

The Secretary reported that, up to date, no official invitation has been received from any country for the holding of the 11th World's Poultry Congress. At the same time he submitted a cablegram from the Central Association of Greek Poultrymen embodying their good wishes for the success of the present Congress and an invitation for the holding of the next Congress in Athens. It was unanimously agreed that the thanks of the Association for their good wishes and the invitation should be conveyed to the Central Association of Greek Poultrymen and to point out that any invitation for the holding of Congress must come from their Government.

It was then agreed in terms of Article XII, section 3, that the following countries should be approached in the order indicated with a view to obtaining an invitation for the next Congress: Belgium, Sweden and Canada.

ELECTION OF OFFICERS

The following appointments take effect from 1st January, 1955:

(a) There were two nominations for the Presidency, Dr. R. Coles (England), and Mr. J. E. Wilson (Scotland). On being submitted to ballot, Dr. Coles was elected.

(b) *Vice Presidents.* The following were appointed Vice Presidents:

Dr. F. Lievens (Belgium), Dr. R. F. Gordon (England), Mr. C. S. Th. Van Gink (Netherlands), Dr. H. Engler (Switzerland) and Mr. Jos. Wm. Kinghorne (U.S.A.)

(c) *Secretary and Assistant Treasurer.* Major Ian Macdougall was appointed Secretary and Assistant Treasurer.

(d) *Treasurer and Assistant Secretary.* Dr. G. F. Heuser was appointed Treasurer and Assistant Secretary.

(e) *Honorary Past President.* Mr. Alex Wiltzer was appointed an Honorary Past President.

ELECTION OF COUNCIL

The following were elected Members of Council for the period (6 years) commencing 1st January, 1955:

Australia	Mr. F. A. Skaller
Belgium	Mr. J. van Ingelgem
Canada	Professor J. R. Cavers and Mr. H. S. Gutteridge.
Denmark	Professor V. Adsersen
Eire	Mr. D. Philpott
France	Professor G. Lesbouyries
England	Dr. D. J. G. Black Mr. E. T. Halnan Dr. H. Temperton
Germany	Dr. A. von Burgsdorff-Garath (3 years) (One vacancy to be filled)
Holland	Mr. J. G. Tukker, and Mr. P. Ubbels
Italy	Mr. F. Garagnani
Japan	Professor Kiyotsuna Sasaki Mr. Jirohiko Kondo
New Zealand	Mr. F. C. Bobby
Northern Ireland	Mr. J. G. Rhynehart
Scotland	Dr. J. Duckworth

Siam	Professor Luang Suwan
South Africa	Mr. G. Hibbert
Sweden	Professor N. Olsson
Switzerland	Mr. H. Ebbell, Dr. E. Hess (3 years)
U. S. A.	Mr. H. H. Alp, Dr. E. M. Funk, Dr. O. B. Kent, Mr. M. C. Small

PUBLICATION COMMITTEE

It was agreed to increase the membership of the present Committee, all of whom were re-appointed, by the addition of the following:

Mr. J. W. Da Costa (Brazil), Dr. H. Havermann, (Germany), Mr. N. Islam (Pakistan), Professor K. Sasaki (Japan) Mr. F. A. Skaller (Australia), and Mr. W. D. Termohlen (U. S. A.)

ADVERTISING COMMITTEE

It was agreed to defer the appointment of this Committee until a later date.

AGENDA

It was suggested that, in future, the Agenda for the Council meeting should be prepared at least 30 days before the meeting. The Secretary pointed out that he delayed the issue of the Agenda until the last possible moment in order to include all matters which were likely to come up for decision.

The meeting then terminated.

Major Ian Macdougall, Secretary.

REPORT of the Secretary of the WORLD'S POULTRY SCIENCE ASSOCIATION

(presented at the Meeting of the Council held on Sunday, 15th August, 1954, in the North British Hotel, Edinburgh, Scotland.)

At each of the two previous Congresses increases in membership were recorded. It is therefore the more pleasing to be able to report on this occasion a further increase in our total membership which at 15th July was 1,543. That total was made up as follows:- Patrons, 10, an increase of 2 over 1951, 145 affiliations, a decrease of 35 and ordinary members 1,388, an increase of 265, making a total increase of 232. For comparative purposes a detailed analysis of the figures for

the different countries for 1939, 1948, 1951 (30th June) and 1954 (15th July) is attached to this Report. I commend a study of this analysis to representatives of many of the countries whose figures of membership are shown therein. While it is always pleasing to report continued increases, the rate of increase is not substantial enough and greater efforts must be made by everyone, and particularly by Members of Council, to enlist additional members. In our Association we have an organisation of international reputation and no opportunity should be lost of adding to its membership and enhancing its prestige. It is worthy of mention that, of the many national and international organisations, ours is one of the few which has maintained the same rate of annual subscription since its inception on 12 July 1912. This reference to the inception of our Association affords us an opportunity of extending our congratulations and good wishes to our dear friend, Mr. W. A. Kock, who is today one of the few, if not the only member, who was present at the inaugural meeting and founding of our Association. The very warm thanks of the Council are due to the following members for their invaluable help in collecting the annual fees and extending membership in their respective countries: Messrs. J. Van Ingelgem (Belgium), V. Hagerup (Denmark), E. Alavano (Finland), A. Wiltzer (France), A. Livshutz (Israel), Prof. A. Ghigi (Italy), Messrs. L. Svendsen (Norway), S. Traskman (Sweden), and the Secretaries of our Branches: Messrs. O. Garlichs (Germany), P. Ubbels (Holland), M. S. Letty (South Africa), and H. Ebbell (Switzerland).

BRANCH ORGANIZATION

Since the previous meeting the Council has approved the formation and rules of the German and South African Branches and is very grateful to Dr. Havermann and Herr O. Garlichs, Messrs. G. Hibbert and M. S. Letty for their initiative and good work in forming these Branches in their respective countries. An application for the approval of a branch in Japan will be placed before the Council for approval at its meeting on 15th August, 1954. There are now 5 Branches firmly established, Germany (84), Holland (80), South Africa (63), Switzerland (63) and the United Kingdom (390). These Branches all play a very important part in maintaining the interest of their members in the work of the Association and in developments in the scientific and practical fields.

REVISION OF THE CONSTITUTION

At the previous Congress a small Committee consisting of Mr. Van Gink, Dr. Heuser and the Secretary was set up to re-examine the Constitution. Some minor amendments were suggested by the Committee. These were approved by the Executive Committee and eventually by the members of the Association in terms of Sections 6 to 8 of the By-Laws.

FINANCES

Audited accounts to 30th June, 1954 will be presented by the Treasurer and Assistant Treasurer to the Council at its meeting on 15th August.

EGG GRADES STANDARDS COMMITTEE

At the 8th Congress in Copenhagen a Committee was set up to recommend standards and grades for eggs and poultry and for containers which would be suitable for general acceptance. The Committee presented an interim report at the 9th Congress in Paris and have since continued consideration of their task. A copy of the report which will be submitted at the Triennial meeting.

EGG LAYING TRIALS COMMITTEE

At the Triennial Meeting of the Association held in Paris, when the report of the Committee was presented, it was agreed that a questionnaire should be circulated with a view to ascertaining the exact purpose of each laying test. It is hoped that a further report will be submitted at the Triennial meeting.

TECHNICAL DICTIONARY COMMITTEE

Following upon the adoption by the Triennial meeting in 1951 that a dictionary of technical terms used in poultry should be prepared in different languages and that the Council should appoint a special Committee to deal with the matter, invitations for nominations and suggestions were sent to all members of Council. The replies received were of a varying nature and considerable concern was expressed in regard to the cost of the compilation and publication of such a dictionary. In those circumstances, and after consultation with the President, it was decided to refer the matter back to the Council at its next meeting.

PRESENTATION OF PAPERS

At the Triennial meeting of the Association in 1951, a resolution submitted by Mr. G. Hibbert (South Africa) in

connection with the procedure governing the presentation of papers at future Congresses was set forward to the Council in the form of a recommendation for its consideration. The views of the Council were invited by correspondence. Some of these recommendations were approved but these were already included in the procedure laid down for the presentation of papers. The recommended procedure now laid down for the presentation of papers at Congresses was submitted to the Scottish National Congress Committee.

WORLD POULTRY SCIENCE JOURNAL

Dr. Heuser has continued his excellent work as Editor of the Journal. Its circulation has increased and it is becoming more and more useful to the scientist and the practical poultry keeper alike.

The Association and Council are grateful to the Chairmen and members of the Publication and Advertising Committees for the valuable assistance they have rendered in connection with the publication of the Journal.

WORLD'S POULTRY CONGRESS

To date, no invitations have been received in connection with the holding of the 11th World's Poultry Congress in 1957.

OBITUARY

Since the last Congress the Association has suffered the loss of three of its members who took a prominent part in its organisation and administration. The first of these was Professor James E. Rice who, in conjunction with the late Sir Edward Brown, founded what was then known as the International Association of Poultry Instructors and Investigators, which subsequently changed its name to the World's Poultry Science Association. Professor Rice's reputation extended far beyond the boundaries of his own country. He was a source of inspiration to all who came into contact with him. To know Jimmy Rice was to love and admire him. The following quotation from Shakespeare can well be applied to him:-

"His life was gentle; and the elements
So mix'd in him, that Nature might stand up
And say to all the world, This was a man."

The second of these was Professor Anita Vecchi of the Institute of Zoology at Bologna University. Professor Vecchi represented Italy on our Council and occupied a prominent place in scientific matters affecting the poultry industry.

Last but not least, Professor Willard C. Thompson who, as reviewer of the World's Poultry Science Association Library, was a well known contributor to the World's Poultry Science Journal. Willard Thompson was no stranger in the United Kingdom. He was the first Director of the National Poultry Institute, Newport, Shropshire, and there are many today who were privileged to have acquired much of their knowledge of poultry matters from his teaching.

MEMBERSHIP

	1939	1948	1951 (30 June)	1954 (15 July)
PATRONS				
Countries	8	8	8	10
AFFILIATIONS				
Australia	1	2	4	4
Canada	1	—	—	—
Denmark	1	1	2	2
England	1	4	5	8
France	1	2	2	—
Germany	1	4	—	8
Holland	—	—	—	8
Pakistan	—	—	1	—
South Africa	—	—	1	—
Spain	—	—	1	1
Sweden	—	—	1	2
Switzerland	—	2	6	7
U.S.A.	6	8	157	105
	12	23	180	145
MEMBERS				
Algeria	1	1	1	2
Argentina	2	1	—	—
Australia	9	15	19	20
Austria	—	3	1	1
Belgian Congo	—	—	—	2
Belgium	17	22	27	28
Bohemia & Moravia	4	—	—	—
Brazil	2	1	4	3
British West Indies	—	1	1	1
Bulgaria	3	1	—	—
Canada	20	30	44	82
Chile	—	—	—	1
China	—	1	1	1
Columbia	—	—	2	4
Costa Rica	—	1	1	1
Cuba	1	1	—	—
Czechoslovakia	—	2	—	—
Denmark	16	13	26	26
Egypt	2	—	1	—
Eire	6	6	17	14
El Salvador	—	1	—	—
England	43	241	284	304
Finland	2	1	5	10
France	17	21	18	23
French Cameroons	—	—	—	1
Germany	36	24	44	75
Greece	—	—	—	1
Haiti	—	1	—	—
Hawaii	—	—	1	2

Holland	22	22	55	72
Hungary	—	2	—	—
India	3	4	5	3
Indonesia	—	—	1	—
Iran	1	—	—	1
Iraq	1	1	—	—
Israel	—	—	9	12
Italy	16	16	15	16
Japan	2	—	1	41
Jordan Kingdom	—	—	1	—
Kenya	—	—	1	1
Latvia	1	—	—	—
Libya	—	—	—	1
Luxembourg	—	1	2	1
Malaya	—	1	1	1
Malta	—	1	1	2
Mexico	—	—	—	2
Morocco	1	—	—	—
Netherland East Indies	1	—	—	—
New Zealand	4	4	6	8
Nigeria	—	—	—	2
Northern Ireland	4	7	14	18
Norway	3	1	12	18
Pakistan	—	2	10	12
Palestine	16	14	—	—
Peru	2	1	—	1
Philippine Islands	—	2	1	2
Poland	3	7	1	—
Porto Rico	—	1	1	1
Republica Dominicana	—	1	1	1
Scotland	3	20	39	53
South Africa	20	3	17	62
Southern Rhodesia	—	—	1	1
Spain	3	3	12	16
Sweden	5	6	40	47
Switzerland	9	11	47	56
Thailand	—	—	1	8
Turkey	1	1	2	3
United States	69	231	323	314
Uruguay	3	2	2	2
Venezuela	—	—	—	1
Wales	—	3	4	7
	373	756	1,123	1,388
Patrons	8	8	8	10
Affiliations	12	23	180	145
Members	373	756	1,123	1,388
	393	787	1,311	1,543

The following countries are included in the list of Patrons:-

Australia, Canada, Eire, England and Wales, Germany, India, Iraq, Northern Ireland, Scotland and the Union of South Africa.

Major Ian Macdougall, Secretary.

GENETICS AND POULTRY IMPROVEMENT*

I. MICHAEL LERNER
University of California, Berkeley, California, U.S.A.

However gratifying to me is the honor of being selected to address you on this occasion, it is matched by the weight of responsibility that I feel in approaching my task. The World's Poultry Congresses have, since their inception, steadily grown in dignity and in consequence, in breadth and in depth. The proceedings of the first congress, a third of a century ago, were but a shade more than a collection of accounts of experiences on an anecdotal level. The poultry business at that time was, except in isolated areas, little more than an array of backyard enterprises. Today, poultry improvement, whether by genetic or non-genetic means, has attained, on the one hand the status of a respected science, and, on the other, of a formidably large industry. It is our duty to approach the deliberations of the coming week in a spirit consonant with this fact. My charge to review the field of research in poultry genetics, to summarize the changes which have occurred in it over the recent years, and to indicate the likely directions which it is to take, is then indeed a grave one.

The venue for our meetings adds further solemnity to this undertaking. Not only is Britain the cradle of animal breeding, but it is also the fountainhead of evolutionary theory, launched by Charles Darwin some hundred years ago, of biometry, fathered by Sir Francis Galton in the last quarter of the nineteenth century, and of experimental study of heredity in poultry, initiated by William Bateson two years before the rediscovery of Mendelian laws. Even closer to our immediate locale lies the site of the classical experiments of Cossar Ewart at Penycuik which dispelled some of the popular fallacies and superstitions about breeding, and practically within call are the Institute of Animal Genetics, the headquarters of the Animal Breeding Research Organization, the Commonwealth Bureau of Animal Genetics, and, above all, the Poultry Research Centre.

Under these circumstances it would be carrying coals to Newcastle to present here merely a recapitulation of the literature on the subject of my talk. It would be an imposition to confine myself to a description of the work of our own lab-

* Address at the Plenary Session of the Tenth World's Poultry Congress in Edinburgh, August 1954.

oratory. It would be an impertinence to use this forum for the airing of my personal opinions on the virtues and vices of the work of others.

It seems to me that a wiser course would be to take my text from the Book of Ecclesiastes,—"Be not righteous over much; neither make thyself over wise; why should'st thou destroy thyself?" Keeping these words in mind, I would like to share with you on this occasion some thoughts provoked by the title of this address, and to attempt an evaluation, subjective as it is bound to be, of the effect the advances in genetics have had on poultry improvement. For the pride of my profession as a geneticist, I might assert categorically that genetics has been one of the most, if not the most, potent influences in shaping the transformation of the poultry industry in the course of the last few decades. Yet in the humility of our ignorance of so many of the biological facts vital for a fuller understanding of that, which we as a group of investigators in poultry science seek to render intelligible, I must also concede that genetics has realized but a minor fraction of its potential worth to the improvement of poultry.

In both these claims I refer to genetics and not to geneticists, because, firstly, much of our progress has come from the efforts of the breeders and not of the scientists, and secondly, there are only too many instances of poultrymen failing to take advantage of the discoveries of the experimenters or looking for keys to doors already open.

We know that productivity is now higher than ever. How much of the increase is due to the conscious employment of sound genetic principles, how much has been achieved by their unconscious or inefficient use, and how much have management, nutrition and sanitation contributed, cannot be told with any certainty. Not every advance in poultry production is due to advances in genetics, but every forward step in genetics has at least a latent import for poultry improvement. It cannot be doubted that developments in the field of genetics have led to significant changes in the philosophy underlying our endeavors, changes reflected both in our objectives and in our methods of striving to attain them. The fundamental purpose in poultry improvement has, of course, remained the same. It is to produce the best genotype for a given environment, and at the same time to establish the optimum environment for the genotypes we have created. But our conception of the genotype, which is the target of our attack, had been modified. The realization that breeding is a stochas-

tic process in which prediction refers not to individuals but to populations and, perhaps, even to populations of populations, has led to a major revolution in breeding practice.

No longer do we tend to confuse the performance of an individual with its hereditary endowment. No longer do we stake our all on the production of a single champion performer. No longer do we proceed as if there were even the remotest chance of being able to reproduce a record-breaking hen as one would a clone of plants. The genotype to which our attention is directed no longer refers to that of solitary exceptional individuals, the goal of showring and racetrack pseudogenetics, but to that of populations. The successive recognition of the facts (1) that individual phenotypes are not the equivalent of individual genotypes, (2) that selection deals with averages and probabilities, (3) that populations are fluid, integrated structures with a physiology of their own, and (4) that they can develop defenses against man's efforts to subvert them to his uses, represents the basis of the important advances contributed by genetics to poultry improvement.

Thanks to the development of population genetics built on these premises, rational grounds (even though they may not as yet have reached desired levels of precision) for exercising choice of methods have become available for the first time in over two millenia of attempts to improve stock by breeding. It may be true that these bases extend so far only to unimproved or partially improved flocks. The important fact is, however, that the earlier systems of breeding, rooted in subjective guesses, dominated by folklore, and essentially qualitative in nature, are giving way to systems, logically derived empirically validated or open to such validation, and founded on a quantitative approach.

Cognizance of the tenets of genetics, realization of their fundamental importance, and awareness of their momentous consequences have come about very gradually, so that the significance of our changed outlook has not been as dramatically highlighted as have some other contributions of science to the poultry industry. Many a breeder today, like Moliere's *bourgeois-gentilhomme*, who did not know until his middle age that it was prose that he spoke all his life, is still a stranger to the fact that he is using the principles of population genetics in his program. Yet in the comparison between 1921 and 1954 the starting contrast between the prevalent modes of thought 33 years apart clearly reflects the impact of genetics on the practical procedures of poultry breeding.

We need cite but a few aspects of the metamorphosis. Foremost of these has been a retreat from the naive attitude that there is a single magic breeding system, on whatever premises it may be based, that could be efficiently applied to any and all traits under improvement. Thus, when mass selection for high egg number was empirically discredited, the demonstration that progeny testing was a superior method of amelioration of this trait was assumed to hold for all characters. Today, however, since we understand that the difficulties of phenotypic selection for egg production are resident in its relatively low heritability, we also understand that characters with high heritabilities are amenable to mass selection. Knowledge of the various factors aiding or impeding breeding progress permits us, at least in theory, to find solutions for problems dealing with the attainment of the most efficient gains in different characters. Because in addition to population-specific properties (e.g. reproductive rate, which contributes to selection intensity and inter-generation interval) there are also trait-specific properties (such as heritability, genetic correlations, non-additive effects under inbreeding), these solutions will be different for different characters, indicating the wisdom of a flexible approach. We know now that mass selection is more efficient than progeny testing in the improvement of egg size, just as we know that sister testing is superior to individual selection if higher egg production is the primary aim, although some aspects of family selection, such as the reduction in the effective size of the population, have not as yet been fully explored. By the use of various genetic parameters, we can devise more efficient programs dealing with several criteria of selection, whether they are addressed to single traits or to aggregates of traits. The same flexibility of approach is, of course, needed for a given character in different stages of improvement: it is well within the realm of likelihood that continuous progress may call for a periodic change of breeding system. This possibility is not yet completely appreciated largely because few systematic breeding programs have been carried on long enough.

Other innovations have resulted as a by-product of studies of population properties. For example, the theoretical demonstration of the advantages of pullet as against hen breeding, which is apparently confirmable in practice, has transformed the mating plans used by many breeders. Time- and labor-saving devices, such as partial instead of daily

trapnesting, even if originally recommended on not entirely convincing grounds, have become accepted and useful methods of procedure, as has also the determination of egg weight from limited sampling. Refinements in testing technique, such as restriction of the length of hatching season or correction for its effects, technical expedients, such as artificial insemination, and a number of other practices have appeared on the scene. Their utility under different circumstances can be now assessed in quantitative terms, and judgment as to their virtues no longer need be based solely on a process of trial and error.

Another great change lies in the breakdown of breed standards as criteria of selection and worth. Crosses between breeds, which were an object of derision not too long ago, are spreading ever more widely, not so much for producing chicks of identifiable sex at hatch, but rather in order to utilize their vigor in both meat and egg production. Closed flock breeding, while nowise outdated, has in many places given way to systematic programs of breed crossing. Within the pure breeds themselves, standard qualities, niceties of color, head points, in fine, the whole concept of a breed ideal has all but expired in the United States and is gravely ill elsewhere. The substitution of operational principles based on genetic theory for esthetic standards has doomed the maintenance of non-economic excellence as a breeding goal of commercial practice. For better or worse, and I must range myself on the side of the optimists, the Standard of Perfection has yielded place to the market report, and must now look for refuge among fanciers and not those to whom poultry is a means to a living.

Our notions about the value of certain mating systems have also undergone a radical modification. Although echoes of debates on the applications of inbreeding still occasionally resound from the pages of the popular poultry press, it has become clear that fixation of productive qualities at a high level of performance is not possible by consanguineous mating as such. Inbreeding instead has become a method of producing parents of outbred stock for commercial use. Attempts to harness hybrid vigor have in recent years claimed the attention of many investigators and breeders. While the full mechanics of heterosis are not yet understood, and although we do not know whether or not intensive inbreeding is, indeed, a prerequisite to this aim, it is obvious that homozygosity in general is neither desirable nor attainable.

One of the consequences of this situation is the increasing use of, what may be termed, two-level breeding operation.

This calls, on the one hand, for improvement within a line, strain or breed of at least reproductive performance, and, on the other, for improvement of commercially useful qualities of crosses between lines, strains or breeds. The outward result, not only of this complication but also of the general expansion of the poultry industry, has been twofold. Firstly, the minimum effective size of a successful breeding enterprise has become larger than the biggest breeding establishment in existence a generation ago. Secondly, the commercial chick is further and further removed from the nucleus under direct selection pressure, although the increase in distance is compensated for by a greater efficiency in attaining and conserving gains made by the breeder. I realize that these statements are more apposite to the situation in the United States than elsewhere, but the trend in the same direction, braked as it may be by local considerations here and there, is unavoidable wherever full advantage of genetical knowledge may be sought.

The catalogue of the various manifestations of changes which have occurred in the last third of a century could be extended indefinitely. My main purpose at this point, however, is to emphasize the fact that underlying them has been the growth of our understanding of the principles of heredity. This applies not only to the original objectives of commercial poultry breeding, which thirty years ago were largely limited to egg number, but also to a profusion of other characters, the betterment of which over the period of years assumed importance as a breeding goal. Some of them, such as egg size, exterior and interior egg quality, meat yield and quality, were created by consumer demand. Others, comprising general viability and resistance to specific diseases, entered the picture because of pressure on the producers for efficient operation. Incorporation into the breeding program of still other characters, such as fertility and hatchability, was dictated by the economics of chick production and restriction of the margin of profit under competition between hatcherymen. New management practices, among which the maintenance of birds in cages and batteries may be cited, have similarly led to new criteria of breeding worth. But all serviceable breeding techniques, to whatever end they are applied, reflect the onward march of genetical theory.

The important steps in its progress include the development first of simple and then the more complex Mendelian algebra, the application of statistical methods to mutifactorial

inheritance, the rise of polygenic theory, the definition of Mendelian populations and the deduction of their integrated structure. The earlier phases of this series are, of coure, no longer news. The latest stages are still in the realm of speculation. But the way has been cleared for investigating many of their important features in requisite detail, and the prospects for obtaining in the near future information of broad utility to breeding practice are excellent.

Some of the questions of immediate concern relate to the evidence that heterozygosity may be obligate at a certain level in flocks of adequate reproductive capacity. The mechanisms which enforce its maintenance in closed populations, the factors involved in the balance between artificial selection, natural selection and mating system, the fate of populations under relaxed or intermittently suspended selection pressure, the discrepancy between computed and actual levels of homozygosity, the bases of non-additive gene action, the rôle of blood-antigen markers in population structure, — all of these come immediately to mind as topics of fundamental significance. Other aspects of population genetics can be readily seen to have an important bearing on our problems. Some of them, for example, the rôle of recurrent polygenic mutation as an impediment to selection progress, relate to explanations of attenuation of gains. Others, such as artificial induction of new genetic variability or the uncovering of existing variation by environmental shocks, may have a more direct influence on raising levels of performance. Still others, such as the exploration of the possibility of incorporating gross chromosomal abnormalities into breeding stocks as a means of copyrighting the breeder's commercial product, are potential technological devices.

These developments and investigations are promising and exciting. Yet we must remember that at best they represent only an unilatral approach to the basic issues. In speaking of the contributions of genetics to poultry improvement I have referred so far primarily to the field of population genetics. Perhaps this is to be expected, not only because I, myself, am more at home in this branch of biology, but also because, after all, animal breeding is basically the application of genetics to populations. At the same time it must also be realized that there exist the sister disciplines of, let us say, physiological and developmental genetics, and that they too can throw much light on questions related to breeding. While much important

work has been done in these fields, I have a feeling that, by and large, it has been divorced from the problems of poultry improvement. In this I do not blame my colleagues who are not statistically minded. I suspect that if anybody is to be censured, it is those of us who have tended to confuse statistical symbols with the biological processes for which they stand. As a Bitish colleague has said in a different context, "the pleasure which many of us (including myself) get from the algebraic reduction of a complex problem must not blind us to this primary need of detailed, extensive and relatively tedious experimentation." And many of us, indeed, fascinated by the satisfactions provided by manipulation of methematical expressions, have been seduced into forgetting that they should have a biological meaning based on the physiological events in the life-cycles of both individuals and populations.

There are many dangers intrinsic in such one-sidedness. Thus, uncritical application of statistical techniques leaves open the possibility that vast and often unrealistic assumptions, originally made to facilitate quantitative treatment, will freeze into dogma and thereby inhibit fresh approaches. In a wider way, it can also happen that, just as the work of the early biometricians, because of their studied neglect of the physiology of inheritance, foundered in sterility, purely formal statistical methods may lead us into a blind alley.

For statistical studies provide us primarily with tools for prediction and only indirectly for understanding. Neither exercises in symbolic logic, nor the use of the latest and most elaborate computing machines, can do much more than lend precision to what we already know. I even have considerable reservations about anything other than an immediately pragmatic value of empirical comparisons between specific breeding systems, especially if selection responses of a population depend, as they must, on its preceeding genetic biography. Of course, the outcome of such pursuits is of great importance to the breeder. Answers obtained from studies of this type will undoubtedly establish narrower predictive limits, which is all to the good, but it is only through understanding of the basic biological processes, that we can do more than refine present-day techniques. For example, no attempt to produce strains with the capacity of laying several eggs a day instead of one can be now seriously undertaken, since the success of such a venture would rest entirely on blind chance.

I do not wish to imply that the statistical vein has been

mined out. On the contrary, only the surface has been scratched, and many problems of imposing magnitude await our attack. I have already mentioned some of them, and even more basic ones can be cited. Thus, very few of the postulates upon which the structure of population genetics has been erected have been unequivocally verified. We do not know even within the framework of our current methods, what the selection limits of different characters are and what controls them. Even the deceptively simple problem regarding the nature of the sampling distribution of heritability values has so far not been solved. We lack even that most essential instrument of statistical analysis of egg laying performance, that is, a probability model.

All these gaps in our knowledge must be and, no doubt, will be closed in due course of time. But apart from the research in progress within each of the compartments of biology, a more comprehensive attack on the totality of problems of stock improvement is needed, if we are to avail ourselves of all the aid which genetics, the unifying science of biology, can offer us. At least I am convinced that only a fusion of methods and ideas from all biological disciplines can disentangle our perplexities, provide the necessary insights, and carry us significantly beyond the *status quo*.

It is, of course, entirely possible that some uncertainty or complementarity principle may defeat us in any case, but we are as yet in no way sufficiently close to the fundamentals to worry about this contingency. A more pertinent question is just how to go about such a combined assault. I cannot say that I have a completely satisfactory plan of action, but others may. In any case a number of ways and means as a starting point can be readily conceived. Granted that we as poultry scientists are not prepared to tell the powers-to-be that, given the tools we can finish the job, there are, no doubt, various possibilities that occur to many of you, as they do to me.

By way of illustration I may cite the approach which is being developed in our laboratory, so far only in a minor fashion. Recent work in population genetics indicates that one of the salient properties of both individuals and populations is their ability to maintain a steady state, or what physiologists designate as homeostasis. In individuals this attribute is apparently based on genetic factors controlling ontogenetic plasticity, the ability to proceed to normal development and function with relative independence from extrinsic stim-

uli, — the property of canalization, or of buffered behaviour. In populations homeostatic faculties are those which maintain an interbreeding group at a genetic composition optimal for the general milieu in which it finds itself.

One possibility is that there are specific genes determining individual stability or, if you wish, plasticity, in the sense that the organism can adapt itself readily to uncontrolled fluctuations in its usual environment. Another is that both developmental and genetic, that is to say respectively individual and population, homoestatic mechanisms are based on heterozygosity. In either case, it seems that improvement of reproductive traits, of which egg number is one and viability another, depends on selection and mating procedures designed to increase the proportion of adequately buffered individuals in our flocks. For instance, the extension of the laying year from a short period in the Spring, characteristic of primitive fowl, to year-around performance in our current domestic stocks represents, in a sense, an augmented independence of the bird from ambient seasonal changes. Selection here has increased buffering powers. Similarly, the alleged superiority of breed crosses over purebreds in individual cages where, contrary to the situation on the floor, birds are unable to seek even partial relief from diurnal fluctations in their immediate environment by moving about, may be a reflection of the higher self-regulating capacity of heterozygotes. Conversely, unidirectional selection for morphological traits leads in small populations to a decrease in reproductive fitness, a fact which may be interpreted as indicating a loss in powers of autoregulation.

From this viewpoint we can surmise that investigation of the physiological and genetic bases of developmental homeostasis presents a propitious opening to an unified study of the biology of the fowl. We know practically nothing of the genetics of normal development and function. We know even less of the genetics of stress response. Only a bare start in the study of behaviour under quasi-constant environment has been made. The effects of maximizing environmental variation have not been broached. Selection for resistance or susceptibility to shocks of various kinds has not been consciously tried in poultry. The dependence of environmental variance of a trait on the genotype has been studied only as a by-product of experiments for other purposes. The genetics of bilateral assymetry in poultry has not been a subject of exhaustive

inquiry. Genotype-environment interactions within as well as between generations have been examined on a very limited scale on the population level, but on the level of individuals, involving the concept of genetotrophic disease in a broad sense (e.g. optimum incubation requirements of different genotypes), they have not been tackled at all.

All these facets of the general problem merit attention. Their full exploration would tax our own facilities beyond all possibilities. And yet they arise from but a single premise. The number of other highways and byways towards our eventual goal is limited only by the inventiveness we can call upon to bear on our problems. I hope that it is not lack of fertility of our imaginations that will be the limiting factor in our progress. For major scientific advances in the long run depend primarily on originality and on daring ideas, perhaps sometimes accompanied by the process described by that wonderful word, serendipity. I do not mean to say that brilliant thinking can ever be subrogated for the wearisome, routine experimental and statistical chores which are the backbone of all research, but we must not lose sight of the fact that the latter is of little avail without the former. Thus, as an example, it is the conception of heritability, and not the determination of the third decimal figure of this constant for some trait in one or more populations, that stands as a milepost in animal breeding. Neither do I wish to embrace in my statement uninhibited interpretations which are simply rooted on ignorance and prejudice, such as those forming the basis of Lysenko genetics. I am merely pleading for a wider outlook on the fundamental issues of poultry improvement to supplement the painstaking and necessary exertions in the specialized compartments of biology that currently occupy most of us.

The complexity and magnitude of a broad undertaking along these lines are such that no offensive through any single subdivision of biology can succeed. That is why co-operative inter-disciplinary efforts are becoming increasingly important. Even more vital for the accomplishment of the task before us is freedom from pressure to produce results of immediate utility. Work for these ends should in the present stage be assigned to the province of industry rather than of the experiment station. At least in the United States such a tendency is already discernible, if the number of professional

geneticists employed by poultry enterprises is any index. The search for empirically successful breeding programs is their legitimate function, since solutions of immediate technological problems, while of signal moment to any breeder operating in the field today, are only of transient interest when the more fundamental aspects of poultry biology are contemplated. It is research in the latter that will ultimately pay off in a larger way. That is why it needs protection, cultivation and encouragement. Basic research can flourish only under conditions of detachment that permit it to address itself to its ends in a co ordinated manner.

Because of this fact we should expect one of our host institutions, the Poultry Research Centre, to be the leader in our quest. I do not mean this as an empty compliment but as a challenge, because I believe that only such an organization attempting a combined attack from the advanced positions of genetics, physiology, endocrinology, animal behaviour, nutrition, and a multitude of other sciences, has an opportunity to accomplish what is needed.

And now, just as my opening text was borrowed from Ecclesiastes, so allow me to conclude in the same way by echoing, what I feel may be, your sentiments at the moment: "Better is the end of a thing than the beginning thereof." I only wish to add that in spite of all the difficulties ahead of us, I am sure that we can look forward to the next third of a century with considerable confidence. The first step, the most significant one, that of introducing scientific method into poultry improvement, has already been taken. I have little doubt that those of us lucky to survive long enough to attend the 20th World's Poultry Congress will know a good many answers to the questions raised at the 10th. But I am also certain that new quandaries and new problems as acute as those of today will face us then. Science lives in a state of perpetual crisis with one set of ponderous and often seemingly insoluble dilemmas replacing another. The very pursuit of truth, as much as its attainment, is the motive power of scientific endeavor. To enable the poultry scientists of the future to carry on, to prepare the ground for our successors, should be our most important mission. We have built on the foundations laid by our forerunners. To them we owe a great debt. Let us do as proud by our heirs as we have done by our predecessors.

THE ADVANCE OF POULTRY NUTRITION*

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The rapid progress of modern nutritional science has been often dependent upon discoveries which were made with poultry. The ease with which chicks may be obtained and used as experimental animals has been of great use in the identification of some of the vitamins. This was especially true when conditions made it difficult to devise a basal diet to produce the uncomplicated deficiency.

About twenty years ago some of us were greatly impressed by the fact that it was not possible to construct from purified foodstuffs a diet which would support life in baby chicks for more than three or four weeks, even when vitamin concentrates were included which represented the best knowledge of that era. It was plainly evident that the preceding 150 years of experimental science had done little to provide the answer as to the nutritional needs of chicks. Progress was soon forthcoming and the years between 1934 and 1950 saw a rapid development and increase in the knowledge of poultry nutrition. One by one, the essential vitamins were identified and purified. Simultaneously the dietary role of the amino acids in chick growth was studied and by 1946 reproduction was obtained in chickens on a purified diet.[1] A further improvement in nutrition followed when it was found in studies with chicks that the addition of small quantities of antibiotics to the diet produced an increase in the growth rate of young animals. These advances were so striking that in the years following 1950 it may well seem that the progress of new ideas has slowed to a point where it is necessary to apply the existing knowledge rather than to expect sudden changes.

My talk today will be largely confined to a discussion of experimental work in poultry nutrition during the period 1951 to 1954. The number of publications dealing with this subject was undoubtedly greater in the past three years than during any corresponding preceding period. The feeding of poultry was once a by-product industry and chickens were fed largely on the surpluses and wastes from the production of other crops. Such is no longer the case, the protein concentrates due to their value in poultry feeds are now more important

* Address at the Plenary Session of the Tenth World's Poultry Congress in Edinburgh, August, 1954.

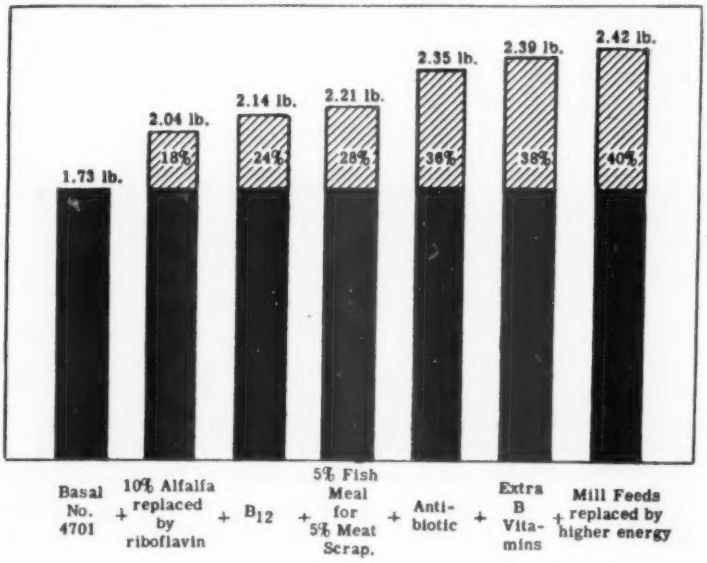
than the fats and oils from the manufacture of which the same protein concentrates were formerly a by-product. Special chemical industries have been developed to supply vitamins, antibiotics and anticoccidial drugs to satisfy the needs of the poultry feed industry.

The influence of progressive changes in the basal diet during the period 1947-1952 on the growth rate of chicks is strikingly illustrated by the findings of Kinder and Kempster[2] (Figure 1). The changes included the replacement of alfalfa meal by riboflavin, the additions of vitamin B_{12}, fishmeal, antibiotic, extra B-vitamins and the replacement of mill feeds by high-energy ingredients. In 1947 the chickens weighed 785 grams at 8 weeks and in 1952 following the six dietary changes the corresponding weight was 1100 grams.

ANTIBIOTICS IN POULTRY NUTRITION

The past three years have seen an assiduous exploration of the nutritional effects produced by antibiotics in the diets of chickens, and 63 papers on this subject have appeared in one journal (Poultry Science) during this period. Many of these investigations were concerned with the nature and extent of the improvement in growth which is produced by adding antibiotics to the diet of supposedly healthy chickens.

Figure 1. Influences of changes in basal diet, 1947-1952.



This may be termed the "antibiotic growth effect." The existence of this effect compels a revision of some of the older concepts of nutrition. The bacteria which live in the intestines of animals cannot be regarded simply as passive saprophytes or as beneficial collaborators. We must conclude that the intestinal bacteria normally include organisms which actively interfere with the nutrition of the host. The numbers and types of these bacteria may vary greatly and beyond a certain point intestinal and systemic disease becomes evident. Several laboratories have noted that the antibiotic growth effect is reduced or eliminated by taking steps to lessen the bacterial population in the external environment of the chick. It now appears that no growth response to antibiotics occurs in bacteria-free surroundings such as may exist in the developing chick embryo or in "germ-free" chicks, while Coates and her collaborators at Reading have shown in several experiments that the growth response to antibiotics may be markedly diminished when the chicks are reared in specially-constructed plastic cages which are designed to exclude bacterial contamination.[3] Under less rigorous conditions the growth response to antibiotics may be small or absent, although exceptions to this generalization have been recorded, for in truth sterility of the intestinal tract, like the well-known example of pregnancy, would seem to be an "all or none" phenomenon. Many investigations with antibiotics both in the clinical field and with experimental animals have shown that the bacterial content of the feces tends to increase following a short initial decrease when antibiotics are administered for prolonged periods. An explanation of the effects of antibiotics upon nutrition must therefore be sought in qualitative rather than quantitative changes in the bacterial flora. The presence of a luxuriant flora in the intestines of antibiotic-fed animals makes it unlikely that the growth response is due to a simple removal of bacteria from competition with the host for the supply of alimentary nutrients.

The relation between dietary antibiotics and various anabolic phenomena has been described. Sparing effects of antibiotics on the quantitative requirement for a number of vitamins are evident. These vitamins include thiamine, riboflavin, niacin, folic acid, biotin and vitamins A and D. In other investigations, no sparing effects were found; perhaps this reflects variations in the intestinal bacteria of the experimental animals. The results enable us to generalize that the common antibiotics used in poultry diets do not produce an effect re-

sembling that of the sulfonamides in rats. The latter drugs when added to purified diets for rats and certain other experimental animals produce deficiencies of certain vitamins which the rat may obtain from its intestinal microflora. It should be noted that the sulfonamides do not produce this effect on adequate diets and that the effect of antibiotics appears to be in the opposite direction, namely, they have led to an improvement in the intestinal bacterial synthesis of B-complex vitamins. There is a possibility that feeding antibiotics may also lead to an increase in the production in the intestine of certain unidentified nutritional factors. Evidence for this has been presented by Slinger and by Romoser.[4,5] Slinger and coworkers obtained viable coliform cells from the feces of chicks which had received penicillin. When these cells were fed to other chicks, an improvement in feed consumption was observed. Along similar lines, Romoser and co-workers suggested that when penicillin and lactose were fed together in their experiments certain bacteria might have been stimulated which produced a growth factor

The diverse nature of the nutritional effect produced by adding small quantities of antibiotics to the diet of chicks has led to much speculation concerning the reason for these effects. It is attractive to return repeatedly to the concept that these interesting substances may produce effects which are both systemic and antibacterial. However, we know very little about the effects on nutrition which are produced by the billions of bacteria within the digestive tract. It is therefore quite unsafe to postulate that the nutritional effects of antibiotics are due to any cause other than their effect upon the intestinal bacteria.

A relation between infection and certain symptoms associated with dietary deficiencies may exist. We noted in 1951[6] that the mortality rate of chicks on a diet deficient in vitamin B_{12} could be reduced by adding either vitamin B_{12} or Aureomycin to the diet as shown in Table 1. A more extensive study along similar lines was made by Slinger and Pepper[7] who noted that turkeys were protected by an antibiotic against a syndrome characterized by broken feathers, perosis, diarrhoea and dermatitis which was observed on a supposedly complete diet. When deficient diets were used, antibiotics continued to have an effect in preventing diarrhoea and broken feathers. Furthermore, these authors note that this syndrome in poults, once common in Ontario, has largely disappeared following the inclusion of antibiotics in commercial diets.

TABLE 1

Effect of Aureomycin in Mortality in B_{12}-Defiicient Chicks

Expt. No.	B_{12} per KG diet, mg.	No Aureomycin	Aureomycin
1	0	25	8
2	0	58	8
	5	58	8
3	0	7	0
4	0	67	16
	5	41	8
5	0	50	31
	2	56	12
6	0	87	25
	3	50	0
7	0	6	0
8	0	87	37
	3	56	6
		+	+
	Average	50—24	12—11

100 mg. Aureomycin per Kg. diet, except 50 mg. in Exp. 6.

The difficulty of separating an "antibiotic growth effect" from generalized reduction in morbidity has long been apparent to us and under practical conditions in congested areas of poultry rearing we know that antibiotics can play a vital role in reducing losses. These substances are another weapon in the war against harmful bacteria of all types and the work of Dr. Robert White-Stevens and his collaborators in our laboratory and in our field experiment stations has shown that this weapon is indeed effective. Serious economic losses have occurred in the broiler areas of the United States resulting from an ill-defined condition termed chronic respiratory disease. It has been found possible to reduce these losses by feeding comparatively high levels of Aureomycin in the order of 100 grams per ton of diet. In these studies a consistent trend has been found in experiments involving several hundred thousand chickens in groups containing from 100 to 400 birds. Among the effects are a reduction in mortality and culls, an improvement in growth and an increase in the efficiency with which food is converted to body weight. These improvements were observed in comparisons made with birds receiving lower levels of antibiotic, such as 10 grams per ton of feed. An example of these experiments is shown in Table 2.

The effect of antibiotics on reproduction in poultry has been studied under various conditions. The Beltsville group found that Aureomycin improved the hatchability of eggs of pullets which received a diet deficient in vitamin B_{12}, but no such effect was obtained when the supply of vitamin B_{12} was

TABLE 2

Results with Various Levels of Aureomycin Fed to Barred Rock X New Hampshire Chickens Under Broiler Farm Conditions. (White-Stevens unpublished data)

	Grams antibiotic per ton of diet			
	10	50	100	200
No. of birds started	2500	4600	4600	6000
Av. wt. at 78-80 days (Kg.)	1.41	1.53	1.53	1.69
Total wt. per 1000 started (Kg.)	1356	1480	1484	1651
Feed per Kilo gain	3.17	3.07	2.71	2.93

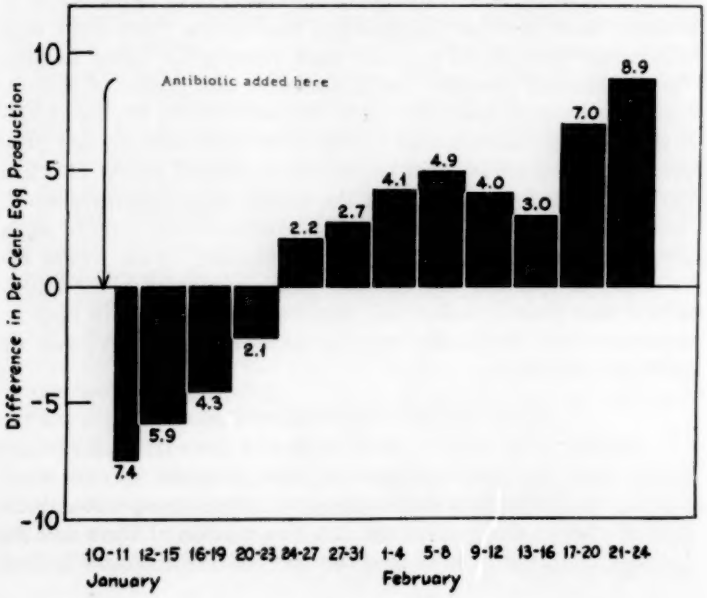
adequate.[8] A large number of investigations[9] in the United States resulted in findings that the commonly-used antibiotics under the conditions studied had no deleterious or beneficial effects upon egg production by presumably healthy birds in good lay. Couch and his collaborators used small numbers of hens kept in cages and found that egg production was increased when antibiotics were added to the diet.[10] In most investigations, however, no such increases were found, including an extensive experiment by the group at Washington State College.[11] These investigations were carried out under sanitary conditions and the egg production by the unsupplemented birds was high. Accordingly, we sought a somewhat different approach to the problem and studies were made of the effects of feeding high levels of Aureomycin to laying hens showing mild signs of chronic respiratory disease. In one experiment, a breeder flock of New Hampshires containing 2916 hens and 252 males were found to show such signs after being in production for ten months. The addition of 100 grams of Aureomycin per ton of feed was made for half of the flock and the supplemented hens showed a steady improvement in egg production as compared with the unsupplemented group (Figure 2).[12] During the final week of the 45-day experimental period, the birds receiving the antibiotic produced 7.9% more eggs than the unsupplemented hens on a hen-day basis. These results are interesting, but of even greater interest is the implication that mild diseases may depress reproduction in poultry and that this depression may in some cases be reversed by antibacterial action.

NUTRITIONAL ENCEPHALOMALACIA

Blaxter and Brown[13] have reviewed the earlier literature concerning the interrelations between vitamin E and other dietary components in producing nutritional encephalomalacia and exudative diathesis in chicks. The studies of Dam and his collaborators[14] have indicated that certain antioxidants includ-

ing ascorbic acid and nordihydroguaiaretic acid share the properties of vitamin E in preventing exudative diathesis. Zacharias and co-workers[15] showed that ascorbic acid would also prevent nutritional encephalomalacia in chicks on a diet deficient in vitamin E. More recently the problem of nutritional encephalomalacia has been studied by Singsen, Matterson, Jungherr and their collaborators in view of its occurrence under field conditions. The Connecticut group[16] during the past three years have conducted 47 experiments comprising over 400 groups and over 8000 chicks. Studies of the content of blood tocopherol and histological examination of the brains of large numbers of these chicks have been made. Their findings indicate that very low levels of vitamin E intake did not affect egg production or adult mortality over a period of 9 months but the vitamin E reserves of chicks were greatly reduced by lowering the vitamin E content of the breeding ration of their mothers. These chicks showed a high incidence of encephalomalacia when they were fed a diet containing 2% fish oil. Protection against encephalomalacia was obtained by adding either tocopherol or diphenyl-para-phenylenediamine to the diet. The latter substance was effective at a level of 0.025% of the diet. Of great interest was an observa-

Figure 2. Effect of antibiotics on egg production.



tion that biweekly intramuscular injection of diphenyl-paraphenylenediamine were effective in protecting against the deficiency disease in the same manner as when the substance was included in the diet.[17] The effectiveness of this cheap antioxidant in protecting chicks against nutritional encephalomalacia is one of the most interesting developments in poultry nutrition. Other antioxidants have been examined with varying effects. One of the effective antioxidants is 6-ethoxy-2, 4-trimethyl-1, 2-dihydroquinoline which has been found useful in preventing oxidation of the carotene in alfalfa meal.[18] Such new chemical additives may therefore solve the twofold problem of protecting both vitamin A and vitamin E in feeds from oxidation by air. The antioxidants may also have an *in-vivo* function improving the utilization of vitamin E in the tissues of chicks.

UNIDENTIFIED VITAMINS

A new coenzyme substance, thioctic acid or lipoic acid, was isolated from liver by Reed and co-workers[19] and by Patterson and co-workers.[20] Chemical investigations in our laboratories have shown that this substance is,[6] 8-dithio-octanoic acid. Thioctic acid is known to be concerned with the biological oxidation of pyruvate and our group[21] has shown that the amount of thioctic acid in the egg increases rapidly during the development of the chick embryo.

A revival of interest in the so-called vitamin B_{13} is shown in a recent publication by Manna and Hauge[22] who have reported an improvement in growth when fractions from distillers' solubles were fed to rats on diets deficient in vitamin B_{12}. Orotic acid gave a similar but less marked response. Rasmussen and co-workers[23] working with chicks found that a similar fraction prepared from distillers' solubles produced growth responses in chicks when the concentrates were added to a special diet. Substantially larger responses were produced by crude materials and especially by liver residues. Orotic acid gave some response but the so-called vitamin B_{13} concentrate was almost completely free from this substance.

Many investigators have noted improvements in growth when certain crude feeds are added to the diet of chickens. Prominent among these materials are fish solubles, distillers' solubles, dried whey, liver extracts and microbial fermentations. A large number of articles have been published which have reiterated the theme that these feeds contain an unidentified growth factor for chicks but progress on the isolation and identification of these growth factors has been disap-

pointingly slow. Apparently, it is seldom possible to keep the assay going for lengths of time which will permit a chemical characterization of the growth-promoting factor and so far no basal diet or nutritional conditions have been devised which will produce more than a slight to moderate growth difference in favor of the supplemented chicks, nor is it clear that such supplements will produce a growth stimulus when added to a basal diet containing high levels of antibiotics.

AMINO ACIDS

The requirement of chicks and turkeys for the essential amino acids was studied by several groups of investigators, notably by Almquist and his collaborators[24] during the 1940's, and the broad picture of the requirements was well delineated by these investigations. Almquist has continued to add finer details in his more recent studies and he has reiterated the postulate that chicks require all the nutritionally indispensable amino acids in definite proportions over a wide range of growth rates. Straight line ratios were found when the per cent rate of gain was plotted against the logarithm of the level of several amino acids in the diet until a plateau was

TABLE 3

Per Cent of Each Indispensable Amino Acid Required in the Diet When All Other Amino Acids of Nutritive Importance are Provided.

Amino Acid	Young Rat	Young Chick	Young Turkey
Arginine	0.2	1.2	1.6*
Histidine	0.4	0.15	
Lysine	1.0	0.9	1.5*
Tryptophan	0.2	0.20	0.26*
Methionine	0.5	0.45	0.55*
Phenylalanine	0.7	0.9	
Leucine	0.8	1.4	
Isoleucine	0.5	0.6	0.8*
Valine	0.7	0.8	
Threonine	0.5	0.6	
Glycine	0.0	1.0	1.0*
Approximate protein level	20	20	28

From Almquist, 1953.

* Estimated from requirement found with protein level different from that indicated.

reached. The relative requirements for several of the amino acids is shown in Table 3. Synthetic methionine has gained some use in practical diets for poultry, especially when the proteins are largely of vegetable origin.

EXPERIMENTAL ATHEROSCLEROSIS

Chickens have been used recently by several investigators in experimental studies of atherosclerosis and this subject has been reviewed by Katz and Stamler.[25] Birds which received a

commercial diet supplemented with several per cent of cholesterol dissolved in vegetable oil were reported to develop gross atherosclerosis within a few weeks. Discussion of the field is beyond the scope of my subject but it is of interest to point out the existence of this field of study in relation to poultry nutrition.

METHYLATING AGENTS

Folic acid and vitamin B_{12} are concerned with the metabolism of the "single-carbon unit" which may be defined as a chemical fragment which can form a methyl group or substituted methyl group to be used in the formation of choline, methionine, creatine, thymine and other biologically important compounds. Biological studies with methionine indicate that it can be formed from homocysteine either by direct methylation or by a less direct process which involves stepwise reduction in which folic acid and vitamin B_{12} are catalytically involved. Our experiments with chicks on diets multiply-deficient in folic acid, vitamin B_{12}, methionine and choline indicate that the methionine requirement of chicks is increased when they are deficient in folic acid, vitamin B_{12} and choline. It may be concluded that dietary methionine may be wasted unless nutritional requirements for its biological ultilization are supplied in the diet. The results of some of our experiments are shown in Table 4 and 5 and Figure 3.[26]

CONCLUSION

Many of the fundamental questions of the dietary requirements of poultry have been answered by scientific investigators during the past 20 years. Much information on nutrition

TABLE 4

Growth of Chicks with Various Supplements to Diet Deficient in Folic Acid, B_{12}, Methionine and Labile Methyl

Group No.	Addition per Kilo of diet			Gain in 28 days	Increase due to vitamin addition
	Folic Acid	B_{12}	Methionine		
	mg.	Y	g.	g.	g.
1	—	—	—	41	
2	2	—	—	62	21
3	—	50	—	76	35
4	2	50	—	142	101
5	—	—	2	148	
6	2	—	2	184	36
7	—	50	2	182	34
8	2	50	2	247	99
9	—	—	4	254	
10	2	—	4	247	—7
11	—	50	4	260	6
12	2	50	4	260	6

was published in the years 1951 to 1954, especially with respect to antibiotics, vitamins and amino acids. The effects on infectious disease have become increasingly prominent in the

TABLE 5

Growth of Chicks with Various Supplements to a Diet Deficient in B_{12}, Methionine and Labile Methyl

Group No.	Choline	Betaine	Dimethylthetin	Methionine	B_{12}	Gain in 28 days	Increase due to methyl supplement
	g.	g.	g.	g.	Y	g.	g.
1	—	—	—	—	—	98	
2	2.8	—	—	—	—	229	131
3	—	3.0	—	—	—	238	140
4	—	—	2.3	—	—	219	121
5	—	—	—	4.0	—	247	149
6	—	—	—	—	50	183	
7	2.8	—	—	—	50	261	78
8	—	3.0	—	—	50	259	76
9	—	—	2.3	—	50	241	58
10	—	—	—	4.0	50	293	110

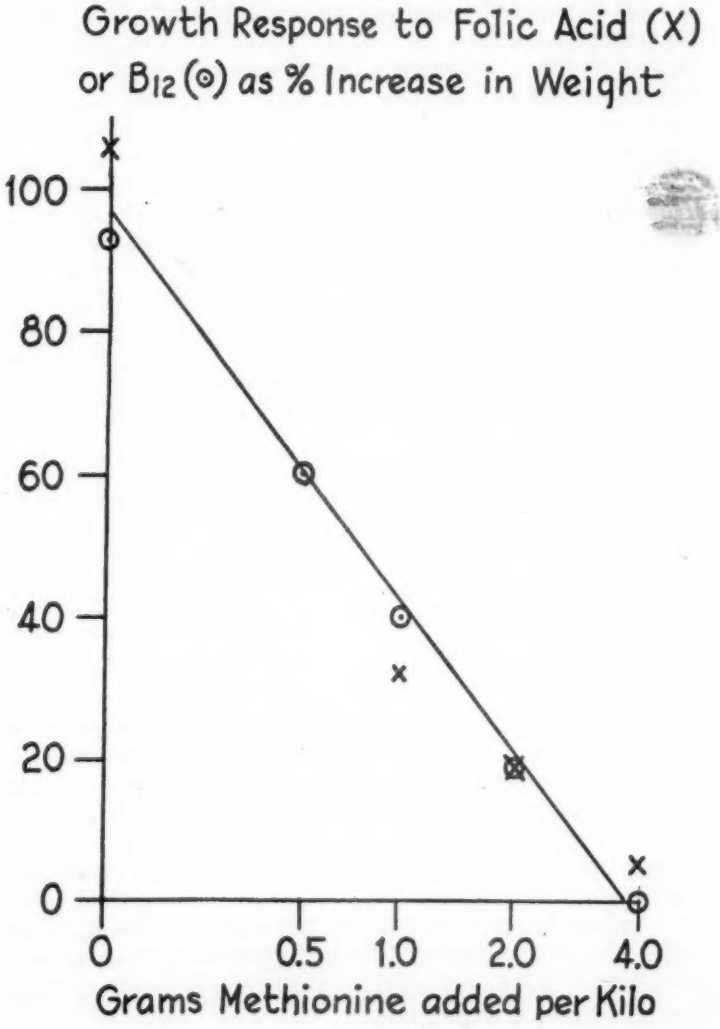
poultry industry in the face of intensive rearing conditions. The study of poultry nutrition continues to provide opportunities for putting fundamental findings to practical use.

REFERENCES

1. Jukes, T. H., and E. L. R. Stokstad. Proc. Soc. Exper. Biol. & Med. 63: 157, 1946.
2. Kinder, Q. B., and H. L. Kempster. Research Bulletin 525, Missouri Agr. Exp. Station, 1953.
3. Coates, M. E. Chemistry and Industry. In press.
4. Slinger, S. J., M. M. Hauser, and W. F. Pepper. Poultry Sc. 32: 925, 1953.
5. Romoser, G. L., M. S. Shorb, G. F. Combs, and M. J. Pelczar, Jr. Antibiotics & Chemo. 2: 42, 1952.
6. Stokstad, E. L. R., and T. H. Jukes. Proc. Soc. Exper. Biol. & Med. 86: 73, 1951.
7. Slinger, S. J., and W. F. Pepper. Poultry Sc. 33: 633, 1954.
8. Sizemore, J. R., R. J. Lillie, and H. R. Bird. Poultry Sc. 31: 935, 1952.
9. Summarized by T. H. Jukes and W. L. Williams. Pharmacol. Rev. 5: 381, 1953.
10. Couch, J. R., J. F. Elam, and L. L. Gee. Federation Proc. 10: 379, 1951.
11. Berg, L. R., J. S. Carver, G. E. Bearse, and J. McGinnis. Wash. Agr. Exp. Station Bulletin 534, 1952.
12. White-Stevens, R. H. Unpublished observations.
13. Blaxter, K. L., and F. Brown. Nutr. Abstracts and Reviews 22: 1, 1952.
14. Dam, H. I., I. Kruse, I. Prange, and E. Sondergaard. Biochem. Biophys. Act 2: 501, 1948.
15. Zacharias, L., P. Goldhaber, and V. E. Kinsey. J. Nutr. 42: 359, 1950.
16. Singsen, E. P., L. D. Matterson, A. Kozeff, R. H. Bunnell, and E. L. Jungherr. Poultry Sc. 33: 192, 1954.
17. Singsen, E. P., R. H. Bunnell, L. D. Matterson, A. Kozeff, and E. L. Jungherr. Poultry Sc. 1954. In press.
18. Bickoff, E. M., E. L. Livingston, J. Guggolz, and C. R. Thompson. J. Am. Oil Chemists Soc. 29: 445, 1952.
19. Reed, L. S., B. De Busk, I. C. Gunsalus, and C. S. Hornberger, Jr. Science 114: 93, 1951.

20. Patterson, E. L., J. A. Brockman, Jr., F. P. Day, J. V. Pierce, M. E. Macchi, C. E. Hoffman, C. T. O. Fong, E L. R. Stokstad, and T. H. Jukes. J. Am. Chem. Soc. 73: 5919, 1951.
21. Stokstad, E. L. R., H. P. Broquist, and E. L. Patterson: Federation Proc. 12: 430, 1953.
22. Manna, L., and S. M. Hauge. J. Biol. Chem. 202: 91, 1953.
23. Rasmussen, R. A., P. W. Luthy, J. M. Van Lanen, and C. S. Boruff. Proc. 9th Distillers Feed Conf., 29, March 10, 1954.
24. Almquist, H. J. Poultry Sc. 31: 966, 1952.
25. Katz, L. N., and J. Stamler. Experimental Atherosclerosis. Charles C. Thomas, Springfield, Illinois, 1953.
26. Jukes, T. H. In preparation.

Figure 3. Growth response to folic acid.



RECENT DEVELOPMENTS IN POULTRY DISEASES

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At previous World's Poultry Congresses it has been customary to invite an authority on some disease or group of diseases of particular moment to the poultry industry to read a paper at the plenary session.

On this occasion a departure has been made and I have been asked to review the present position of the more important diseases, particularly from the aspects of control and prevention, and to deal more specifically with outstanding developments which have taken place since the last congress in Paris in 1951.

The subjects of the sectional papers presented to past congresses largely reflect the problems exercising the minds of research workers in this field and provide an indication of the prevalent diseases confronting the industry at that time. The present congress is no exception; fowl paralysis, Newcastle disease and respiratory diseases figure prominently in the programme and those interested are assured of informative discussions at the paper reading sessions. You will therefore not expect a detailed account from me but a general picture of the overall position.

No one with any knowledge of the poultry industry will dispute the importance of disease in determining the degree of profitability or otherwise of an undertaking and all must be aware of the serious financial losses caused by preventable diseases in a poultry population in Great Britain of 53,350,000 with an estimated sales value of eggs and poultry of £147,000,000.

Accurate estimates of these losses are not available and such as we have are apt to be misleading for at first sight a low percentage death rate may be viewed with equanimity or even complacency and its full implication unrealised. For example, an overall loss of 6 per cent. above normal from air sac disease in broilers in a district of the United States of America in 1951 may not seem unduly serious until we find that it represents the death of over 10,000,000 birds and a financial loss of 20,000,000 dollars.

Developments within the industry during its relatively short life are staggering; radical changes in methods of hus-

* Address at the Plenary Session of the Tenth World's Poultry Congress in Edinburgh, August, 1954.

bandry have taken place which have completely altered our conception of the importance of certain diseases. The incidence of some has waned to insignificance; others have assumed much greater importance and their adequate control has presented many problems.

Diseases spread in the incubator have assumed a greater importance through increase in the number and size of hatcheries and the risk of acquisition, propagation and dissemination of infection is proportionately greater in the larger establishments drawing supplies of eggs from several sources. The greater use of intensive systems of poultry-keeping in which large numbers of birds are housed in a single unit increases the risk of respiratory diseases, and an outbreak of infectious disease on the premises of any of the large suppliers of growing stock may lead to its dissemination literally throughout the length and breadth of the country, e.g., following a single outbreak of Newcastle disease, routine tracing of sales revealed a further 163 outbreaks and many more were detected during the following months. The activities of poultry dealers present an almost insuperable problem in disease control.

There is merit therefore in considring the present shape of the ever changing, closely interwoven pattern of husbandry and disease. Already complex, it is likely to become still more complicated as fresh and possibly novel systems of husbandry are evolved. Valuable lessons can be learned from the past for pioneers of new methods of poultry-keeping have inevitably been confronted by unforseen disease problems. These have acted as a spur to research workers and have been overcome; typical examples which come readily to mind are the deficiency diseases met with in the early days of intensivism and the problem of pullorum disease which became acute following the introduction of the mammoth incubator.

The disease of greatest economic importance is probably fowl paralysis and those associated conditions often referred to as the leucosis complex. A great deal of confusion has arisen over the classification and nomenclature of this group of diseases; muddled thinking and irresponsible writing have led to the unsatisfactory position in which the term "leucosis" has become almost synonymous with any of the forms of leukaemia, neural, visceral or ocular fowl paralysis, sarcomatous tumours and even osteopetrosis, and statements, pertinent for one or other entity have been interpreted glibly as generalisations by scientists who ought to have known better.

The position is now becoming clarified and there are sound grounds for considering the various forms of leucosis, and the three types of fowl paralysis, not as manifestations of a single disease but separate entities with different causative agents. This is particularly gratifying to those of us who have always considered from our experimental work that the diseases are separate and have consistently tried to distinguish between the various types.

Research has not yet provided solutions to all aspects of fowl paralysis but much is now known of its nature and methods of spread, and certain control measures at least partially successful have been evolved.

During the period under review several important papers have come from the Regional Poultry Research Laboratory at East Lansing, specially set up to investigate fowl paralysis by the United States Department of Agriculture under the directorship of Mr. Berley Winton and from Cornell University by Professor Hutt and his colleagues. I am greatly indebted to Mr. Winton for allowing me access to several unpublished papers describing the most recent work of his staff.

It has been well established, and is generally accepted, that the resistance of different individuals varies greatly, and that this is an inherited quality; resistant and susceptible lines of fowls can therefore be built up and maintained. It is also recognized that susceptibility is greatest during the first few weeks of life and that the disease may be largely controlled, even in susceptible stock, by isolation during this critical period. The incidence in any flock ultimately depends on the degree of inherited resistance it possesses and the weight of infection to which it is exposed, for resistance is not absolute. According to Hutt the severity of exposure is closely related to the proximity of adult birds. Support for this observation has been provided by recent work at East Lansing (Burmester and Gentry 1954) where it has been shown that the causative agent of visceral fowl paralysis is present not only in the oral secretions and in the faeces of naturally and artificially affected birds but in the discharges of apparently healthy birds. There is little doubt therefore that healthy birds in a flock may be carriers of the disease. A most interesting discovery, the full significance of which has not yet been determined, is the presence of an agent in the faeces of normal healthy birds which inactivates or neutralises the virus. This opens up fresh avenues of thought and suggests numerous fascinating experiments which no doubt will be carried out. Another in-

teresting observation is the persistence of virus in the discharges of birds infected at day-old and the failure to detect virus in birds inoculated when 400 days old. It has also been shown that the incidence of visceral lymphomatosis among birds in contact with experimentally infected chickens is directly related to the proportion of the population inoculated. The methods of spread has been investigated, and conclusive evidence has been produced (Burmester and Gentry 1954) that the visceral type can be set up by introducing the virus into the mouth, nose, eye, trachea or cloaca, or by exposing birds to virus distributed in the form of an aerosol. The respiratory passages are particularly susceptible. This confutes Carr's theory that a skin abrasion, punctured wound or a blood-sucking parasite is necessary for the introduction and spread of infection.

The question of egg transmission of fowl paralysis has always been controversial. The East Lansing workers produced strong positive evidence and stressed the importance of this method of spread; the work at Cornell was equally conclusive in a negative direction. All our work has confirmed Hutt's findings and it was considered that if egg transmission did occur, it was of little epidemiological importance. These results at first sight diametrically opposed are readily reconcilable if it is accepted that the visceral and neural forms of fowl paralysis have different causation; workers at East Lansing were chiefly concerned with the visceral disease, Hutt and ourselves with the neural type.

Cottral, Burmester and Waters (1954) have now produced irrefutable evidence that the agent responsible for visceral lymphomatosis is present in the developing embryo and in the tissues of the newly hatched chick. This important contribution shows that apparently healthy hens in a flock can harbour the agent and transmit it through their eggs. There was no evidence that the neural disease was egg-transmitted, confirming Hutt's experience and providing additonal support for a separate etiology of the two forms of the disease.

The position of osteopetrosis is confusing. Many workers regard this disease as quite distinct from fowl paralysis. It is present in some of the lines at East Lansing and can apparently be produced experimentally but there is no evidence of transmission by contact.

Fowl paralysis has been recorded in most breeds of domestic fowls and bantams and there are rare records of its occurence in turkeys, but what is believed to be the first out-

break in ducks was described by Cottral and Winton in 1953.

In the light of our present knowledge, the measures available for control and prevention of the disease are twofold — (a) the development of resistant lines and (b) isolation of chickens during the period of greatest susceptibility. The former method requires the exposure of young chicks to infection by contact with actively diseased birds. In a fully susceptible stock the results may well be disastrous and there is the additional risk of introducing serious infectious diseases such as Newcastle disease, infectious bronchitis and so on. It is a policy to be undertaken only by large establishments with adequate financial resources to provide for the many additional facilities such a programme requires.

Dr. Coles has pointed out the costly nature of this work and has estimated that it may involve an annual loss of £10 sterling per breeding bird kept over a period of five or six years. The ordinary farmer must be satisfied with less ambitious schemes and it must be admitted that many have apparently succeeded in increasing the resistance of their flocks by breeding from hens which have survived an outbreak of the disease. With regard to the second method, isolation; under the very specialised technique practised at the Lobund Institute at Notre Dame University, Indiana where birds are hatched and maintained under germ-free conditions, fowl paralysis has not been seen in c h i c k e n s from a strain in which the incidence is high (Reyniers 1954). Many workers have reported success with less perfect isolation and under practical farming conditions the incidence can be reduced by rearing chickens well away from adult stock, the provision of separate attendants and careful attention to hygienic procedures. The neural disease is more susceptible to environmental control; in view of the possibility of egg transmission, subsequent isolation cannot obviously entirely prevent the visceral type but it is of interest to note its greatly lowered incidence at East Lansing in 1951 following depopulation and disinfection of the premises the previous year (Waters 1954).

There has been criticism of inadequate research on fowl paralysis, leucosis and associated diseases and of the slow rate of progress. This has been partly due to a lack of knowledge and understanding of normal avian haematology. When basic research on mammalian haematology made its major contribution around the turn of the century the bird was neglected and to attempt to build avian pathology upon a mammalian foundation can be only partially successful. Be-

fore real progress can be achieved, a detailed study of all phases of avian haematology must be made. The serious handicap imposed by this lack of fundamental knowledge may soon be overcome by the publication of an atlas of avian haematology at present in course of preparation at East Lansing by Dr. Lucas assisted by a medical artist Mr. Casimir Jamros. The quality of the work is unbelievably high and the remarkable details of structure and texture achieved by the artist will require the highest standards of engraving for successful reproduction. I make no apology for including this work among the important developments during the period under review. It will be unfortunate if publication is delayed through lack of funds for the book will provide a stimulus to further critical work and be of inestimable help to scientific workers.

Newcastle disease has engaged the attention of research workers in many parts of the world and some important advances have been made since the last congress. It is generally agreed that the slaughter policy in force in Great Britain under the Fowl Pest Order, for all types of the disease irrespective of whether they are caused by the Asian or American virus, is the only satisfactory method of dealing with the acute disease but in many countries protective vaccination is employed in combatting the milder form. The chief trend of research has therefore been the development of more efficient vaccines and improved techniques for their application.

An important feature has been the widespread adoption of intra-nasal vaccines, prepared from the B1 strain of virus of Hitchner and Johnson, often combined with a vaccine for infectious bronchitis. This can be administered intra-nasally or intra-ocularly to chicks from one day old. A similar vaccine made from the F1 strain of virus described by Asplin (1952) has been used successfully in different parts of the world. Wing-web vaccines are useful where conditions permit a delay of 3 to 4 weeks before vaccination. The application of these vaccines requires individual handling of the chicks, a tedious and time-consuming procedure, and especially in the case of the former where there is little or no lateral spread, careless application results in faulty immunisation.

Mass treatment by spraying vaccine over the chicks has been devised by Hitchner and Reising (1952) and Crawley (1953). This has resulted in a great saving of labour — a single operator can deal with 10,000 chicks in 45 minutes. In the opinion of some workers there are drawbacks to the use of the spray method and a vaccine consisting of dried, finely

divided particles of infective chick embryo and fluid residues has been devised by Markham and his colleagues at the Lederle Laboratories division. This is dispersed over the heads of the birds by simple dust pumps of a garden-type duster or aerosol disperser. Large-scale tests have shown the method to be safe, practical and effective. I am grateful to Dr. Markham for allowing me to use this information which was first made public only a fortnight ago at the Poultry Science Meetings at Lafayette, Indiana. Another means of mass vaccination, just reported by Dr. Salsbury, is the addition of B1 virus to the drinking water, suitably buffered. This method, staggering in its simplicity, is said to give an immunity as great as or greater than that produced by intra-ocular or intra-nasal administration. Schmittle's report (1952) of the separation of the serum neutralising antibody from the haemagglutination inhibiting antibody in the gamma globulin serum fraction is of particular interest and provides a sound basis for the observation that immunity often persists in birds which are H. I. negative. An interesting sidelight on the possible spread of Newcastle disease by wild birds comes from Onderstepoort where Kaschula (1952) in a small scale experiment found that virus was present in the faeces of pigeons 12 days after artificial infection. These birds failed to react to the haemagglutination-inhibition test although they were subsequently found to be partially immune.

Mention must also be made of Dr. Beaudette who has continued to publish the outstanding reviews of the literature on Newcastle disease which have come to be associated with his name.

Newcastle disease represents a serious source of financial loss to the poultry industry. Pomeroy and Brandly (1953) estimated that in the United States of America the annual loss is in the region of 40,000,000 dollars with vaccination costing approximately 10,000,000 dollars.

In Great Britain, from 1951 to 1953, there were 2,320 outbreaks resulting in the slaughter of 1,314,726 birds with compensation payments of £1,285,115 (including compensation for the destruction of large numbers of hatching eggs.) A striking feature of the disease in Great Britain has been the effectiveness of control of movement of stock in reducing the number of outbreaks, e.g., the importation of live poultry, hatching eggs and day-old chicks into Scotland from any other part of Great Britain was banned in December 1950. There have been no outbreaks during the past 3 years. Whatever

method of control of the disease is adopted, eradication must be the ultimate objective. It is too expensive a problem to live with indefinitely.

The milder form of Newcastle disease is essentially pneumotropic or neurotropic and so may be considered as a respiratory disease, a group of diseases which has become increasingly important.

Infectious bronchitis is a serious problem in some parts of the world but great strides have been made during the period under review, in developing protective vaccines. The disease is more severe in laying pullets than in younger chicks and previously the only method of protection available was the deliberate exposure of chicks to the disease early in life at a time when its effects were least injurious. Now vaccines, prepared from strains of virus of low infectivity but high immunising properties, are available and as we have seen, may be combined with Newcastle disease vaccines and administered intra-nasally or by atomising a liquid spray or dust; a mild form of the disease is set up after which the birds become solidly immune.

Chronic respiratory disease (C.R.D.), also known as air sac disease, has become a problem of major importance in parts of the United States of America and Canada, chiefly in broiler-producing areas. It is not a new disease but recently its increased incidence and the lack of specific means of control and prevention have suggested it as a greater potential menace to the poultry industry than either Newcastle disease or infectious bronchitis. Although the death rate is not always high there is poor fleshing, a high morbidity rate and a lowered food conversion ratio.

As a result of intensive research at several centres, much interesting and valuable information has been obtained regarding the nature of the causative agent, its means of transmission and methods of diagnosis and control. Tribute must be paid to the work of Delaplane, Fabricant, Hitchner, Jungherr and Luginbuhl, Van Roekel and Olesiuk and others. There is general agreement that the causal agent is a pleuropneumonia-like-organism (PPLO), similar, if not actually identical, with that causing infectious sinusitis of turkeys. One of the most outstanding advances was the definite establishment of egg transmission of the disease by Van Roekel and Olesiuk who demonstrated the organism in the tissues of embryos and young chicks, an observation which had been made earlier in the case of infectious sinusitis of turkeys (Jerstad

and Hamilton 1948). This finding has far-reaching economic and epidemiological implications; the presence of unsuspected carriers of the disease in a flock in the absence of any method for their detection makes control difficult. The haemagglutination-inhibition test recently described by Fahey (1954) from the Connaught Research Laboratories at Toronto may however provide a means of diagnosis.

It is well known that infectious sinusitis of turkeys responds quickly to injection of streptomycin or penicillin into the affected sinus and we have found that intra-muscular injections of larger doses repeated for several days have been successful in alleviating the associated lung or air sac complications. The effect of continuous feeding of high levels of antibiotics on immune responses has received some attention and it has been suggested that levels such as those recommended for the treatment of C.R.D. may have an adverse effect on the development of immunity to Newcastle disease following vaccination. It is obvious that if birds are maintained on levels of any drug which prevents infection, no immunity can develop; Newcastle disease virus however is insensitive to antibiotic treatment. Markham and his colleagues have shown that aureomycin fed at as high a rate as 300 gm. per ton does not inhibit the development of normal immunity.

In the past, many theories have been advanced regarding the aetiology of pullet disease or bluecomb of poultry but recent work in Japan [Watanabe (1952)] appears to provide evidence that a filterable virus is responsible. The disease could be transmitted by feeding or injecting filtered intestinal contents from affected birds and the virus was cultivated in eggs for 14 passages. Bluecomb in turkeys, a serious disease in Minnesota, has been investigated by Pomeroy and Sieburth (1953) who were able to reproduce it regularly by feeding unfiltered intestinal contents but not by filtrates. It is possible that the disease in the two species are distinct.

There have been few developments in the control of salmonellosis. In the agglutination test we have an effective tool for the prevention of pullorum disease and fowl typhoid; that the former disease has not been completely eradicated is due to a failure to make adequate use of the test or through faulty application in the laboratory or field.

The recent discovery that Furazolidone [N-(5-nitro-2-furfuryeidone)-3-amino-2 oxazolidone] shown by Yurchenco and his colleagues to have pronounced antibacterial action

against Gram-bacilli, is effective against fowl typhoid, appears to provide a remedy against a disease which has proved troublesome to control. Dr. Harwood, who found that this drug was effective against blackhead, was the first to suggest its use for fowl typhoid and we look forward to his paper on Wednesday. An article has been published in this country by Williams Smith (1954) and experimental work is being carried out at several centers.

Other salmonella infections may be largely prevented by fumigation of hatching eggs before setting or shortly after wards. We have definite evidence at Lasswade of occasional direct egg transmission so in the few cases in which fumigation apparently fails, but only then, recourse to the agglutination test is necessary.

The extensive use of fertile eggs in the production of living vaccines, e.g. fowl pox, Newcastle disease, infectious bronchitis and others, focuses attention on the necessity for extreme care in the selection of eggs and the desirability of constituting a standard procedure for checking the purity of the finished product. The causal agents of Newcastle disease, infectious bronchitis, epidemic tremor, the visceral form of fowl paralysis, chronic respiratory disease, pullorum disease and fowl typhoid, as well as other members of this group of organisms, have all been isolated from eggs. Neglect of the normal precautions leading to the issue and use of an infected batch of vaccine could have serious consequences.

We must not neglect progress in disease control in other branches of science and there will be general agreement that the discovery of 2-amino-5-nitrothiazole (probably better known as Enheptin in the United States of America and Entramin in Great Britain) by Waletzky (1949) was an outstanding event in the field of chemotherapy, probably second in importance only to the original observations by Levine which lead to the use of sulphonamides for the treatment of coccidiosis.

The later experiments of Swales (1950, 1951) and others confirmed the efficiency of Enheptin in the treatment and prevention of blackhead and this has been further emphasized by extensive experience in the field, where it has proved a boon to turkey farmers everywhere.

Hexamitiasis, another important disease of turkeys, is being investigated at Lasswade, and Slavin has discovered some hitherto unknown aspects of the life history, including a resistant stage which provide a possible explanation of the

carry-over of infection which is a feature of the disease.

During recent years a most puzzling syndrome has been described by several workers, to which the name "haemorrhagic disease" has been applied. Its occurrence has often, but not invariably, followed a period of treatment for coccidiosis with sulphonamides and has suggested the possibility of sulphonamide poisoning. It seems certain, however, that some secondary factors are involved; a concurrent vitamin K deficiency has been suggested in the United States of America but this is not so in this country. Apart from possible toxic effects Kendall and his colleagues at Weybridge have shown that the depressing effect of sulphonamides on early schizogony may interfere with the development of immunity; birds may succumb to coccidiosis after treatment has ceased. As a result of their work an interrupted schedule of treatment (3-2-3) has been recommended as a standard practice in Great Britain.

It might be appropriate here to utter a warning against the growing tendency to consider medicaments of one sort or another as essential components of the normal diet. Their incorporation in proprietary mashes is now extensive. Drugs are valuable aids in combatting disease, but they must be used in a rational manner. While there are circumstances which may warrant their continuous administration, widespread use in this manner appears to be undesirable.

In this country we rather think the current sequence should be, careful observation, prompt and accurate diagnosis followed by immediate treatment. To be successful the emphasis must be on "careful," "prompt and accurate" and "immediate." The growing tendency to regard drug and vaccine therapy as substitutes for good hygiene, husbandry and nutrition is viewed with misgiving. There are no substitutes for these fundamental principles.

Diseases of poultry have never been regarded as of great significance for man although it is well known that salmonellosis and Newcastle disease have occurred in humans through contact with infected birds or other products. In the past, human cases of psittacosis have usually been ascribed to contact with infected budgerigars, parakeets and canaries but turkeys and ducks have been implicated as reservoirs of infection in publications from America (Irons, Sullivan and Rowen (1951)] and Australia [Beech and Miles (1953)] and cases have occurred in this country.

There are many more developments but time forbids their mention. A vast amount of research has been done during the period under review and a pleasing feature has been the valuable work of the scientific staffs of private enterprises and public corporations as well as of Universities and government laboratories; as a result our knowledge of many diseases has benefitted and progress has been made in control and prevention. There is still much to do and increased facilities for research are very necessary. We must expect that fresh disease problems will continue to arise but as a result of accumulated experience and the ever-growing knowledge accruing from current research we may hope to be in a position to minimize, if not eliminate, many of the hazards of disease. Meantime the industry should make full use of measures already available and should learn to rely more on scientific facts founded on experimentation that the dogmatic and opinionative statements of some of its members, however well-meaning, a tendency which in the past has hampered progress in disease control and eradication.

In reviewing the position, this morning, and paying a well-deserved tribute to research workers for their valuable efforts, do not let us overlook the vast debt the industry owes to the diagnosticians. All over the world sterling work is being done by these unseen, unpublicized and, let us be frank, "unfashionable" workers. There are no prizes, no medals for them, nor the glory of discovery. Nor for them the aloofness from practical cares enjoyed by the research worker or the leisurely solution of his problem; only unremitting urgency and heavy responsibilities. They play an essential part in disease control and occupy a key position, maybe the corner stone of the structure.

REFERENCES

Asplin, F. D. (1952) Vet. Rec. 64: 245.

Beaudette, F. R. (1951) Proc. 55th Ann. Meet. U.S. Livestock San. Assn. 108.

(1953) Proc. 57th Ann. Meet. U.S. Livestock San. Assn. 280.

Beech, M. D., and J. A. R. Miles. (1953) Aust. J. Exp. Biol. Med. Sci. 31: 473.

Burmester, B. R., and R. F. Gentry. (1954) Cancer Res. 14: 34.

(1954) Poult. Sci. In Press.

(1954) Proc. Amer. Vet. Med Assn. In Press.

Carr, J. F. (1952) World's Poult. Sci. J. 8: 276.

Coles, R. (1954) Poult. Sci. 33: 350.

Cottral, G. E., and B. Winton. (1953) Ibid. 32: 585.

Cottral, G. E., B. R. Burmester, and N. F. Waters. (1954) Ibid. In Press.

Crawley, J. G. (1953) Proc. 25th N.E. Conf. of Lab. Workers.

Davies, S. F. M., and S. B. Kendall. (1954a) J. Comp. Path. 64(2) pp. 87-93

(1954b) Vet. Rec. 66: pp. 19-21.

Delaplane, J. P. (1949) Proc. 53rd Ann. Meet. U.S. Livestock San. Assn. 193.
Doyle, T. M. (1927) J. Comp. Path. 40: 144.
Fabricant, J. (1953) Proc. 25th Ann. Meet. N.E. Conf. of Lab. Workers. 193.
Fahey, J. E. (1954) Proc. Soc. Exp. Biol. 86: 38.
Hitchner, S. B. (1949) Poult. Sci. 28: 106.
Hitchner, S. B., and E. P. Johnson. (1948) Vet. Med. 43: 525.
Hitchner, S. B., and G. Reising. (1952) Proc. Amer. Vet. Med. Ass. 258.
Hutt, F. B., and R. K. Cole. (1951) Poult. Sci. 30: 205.
Irons, J. V., T. D. Sullivan, and J. Rowen. (1951) Amer. J. Publ. Hlth. 41: 931.
Jerstad, A. C., and C. M. Hamilton. (1948) Poult. Sci. 27: 669.
Jungherr, E. L., and R. E. Luginbuhl. (1952) Proc. 56th Ann. Meet. U.S. Livestock San. Assn. 275.
Kaschula, V. R. (1952) Onderstepoort J. Vet. Res. 25: 25.
Kendall, S. B., and F. S. McCullough. (1952) J. Comp. Path. 62(2) pp. 116-124.
Levine, P. P. (1939) Cornell Vet. 29: 309.
Markham, F. S., A. H. Hammer, P. Gingher, and H. R. Cox. (1954) Abstracts Poult. Sci. Ass. Meet. Lafayette, Indiana. July 26-29.
Markham, F. S., R. J. Price, K. Seeger, and R. White-Stevens. (1954). Ibid.
Pomeroy, B. S., and C. A. Brandley. (1953) N. Cent. Reg. Pub. No. 34 Univ. Minnesota.
Pomeroy, B. S., and J. McN. Sieburth. (1953) Proc. Amer. Vet. Med. Ass.
Price, R. J., C. A. Bottorff, K. Seeger, A. W. Sylstra, and F. S. Markham. (1954) Abstracts Poult. Sci. Ass. Meet. Lafayette, Indiana. July 26-29.
Reyniers, J. A. (1954) Personal communication.
Schmittle, S. C. (1953) Proc. 89th Ann. Meet. Amer. Vet. Med. Assn., Atlantic City: 143.
Slavin, D., and J. E. Wilson. (1953) Nature 172: 1179.
Smith, H. Williams. (1954) Vet. Rec. 66: 215.
Swales, W. E. (1950) Canad. J. Comp. Med. 14: 119.
(1951) Ibid. 16: 57.
Van Roekal, H., and O. M. Olesiuk. (1952) Proc. Amer. Vet. Med. Ass. 271.
Waletzky, E., M. C. Branot, A. Bliznick, and C. O. Hughes. (1949) J. Parasit. 35: 16.
Watanabe, M. (1952) J. Jap. Vet. Sci. 14: 269.
Waters, N. F. (1954) Poult. Sci. 33: 365.
Yurchenco, J. A., M. C. Yurchenco, and C. R. Piepoli. (1953) Antibiotics and Chemotherapy 10: 1035.

In Memoriam

Dr. D. J. G. Black, Reading University, England, Member of the Council of the World's Poultry Science Association for England, January 1, 1949—August 20, 1954

RESPIRATORY INFECTIONS†

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There is no doubt that infections of the respiratory tract are amongst the commonest disease conditions met with in poultry. Although they are not a major cause of mortality in growing and adult stock, as is the case with the leucosis complex, they undoubtedly give rise to serious financial loss from culling, interference with egg production and growth. Unfortunately, owing to the number of different disease conditions involved, they are probably the most difficult group of diseases to diagnose, since the differentiation of the varying forms of respiratory infections is in many cases a laborious laboratory procedure involving difficult and lengthy techniques.

The common respiratory diseases such as fowl pox, coryza and colds have always been with us but a number of different types well established in other countries, particularly in the United States, such as chronic respiratory disease, infectious laryngo-tracheitis, infectious bronchitis and, of course, a mild form of Newcastle Disease (fowl pest) are now becoming equally common in this country. Furthermore, most respiratory diseases are, to a large extent, associated with environmental conditions and predisposing factors such as overcrowding, faulty ventilation, closeness of contact and malnutrition, play a big part in the spread of these infections. There is no doubt that husbandry methods which facilitate closeness of contact encourage the spread of these infections and they are likely to become even more prominent with the increased use of highly intensive methods of housing, such as the built-up litter system of broiler production, battery brooding and the like. A previous worker has likened these predisposing factors to the spread of colds in humans in over-crowded cinemas, trains, etc. There is little doubt that when birds are kept extensively, these conditions do not spread to the same extent, mainly as the result of the decreased cross infection from droplet, or air-borne infection. Husbandry methods where there is a continuous food or water supply would also play an equally prominent part, since many of these diseases are not only spread by inspiration of infected dust and droplets, but also by contact with contaminated food and water.

The nutritional influence must also be stressed, since in

†From a paper given at Harper Adams Conference, England, Sept. 17, 1953.

particular vitamin-A deficiency frequently co-exists with conditions such as coryza and it is probable that a deficiency of this vitamin reduces the resistance of the cells lining the respiratory tract.

Although husbandry conditions in themselves do not produce these diseases, this correlation must be borne in mind throughout the whole of this discussion and this talk is an attempt to clarify the relationship of the various disease processes which may affect the respiratory tract of the fowl and to outline the varying clinical symptoms and the different control measures available. It may seem of only academic interest to you that these virus conditions should be differentiated and given separate names but I am sure you will appreciate the importance of this if any real progress is to be made in the treatment and control of these diseases.

Not so many years ago all diseases affecting the head and the respiratory tract of the fowl were commonly called "roup" and it was customary to recommend straight forward sanitary measures, perhaps the addition of antiseptics to the drinking water, and so on. It is now evident that these measures only appear to be effective, as in most cases the disease stops of its own accord because the susceptible animals have died or become immune and not because of any benefit from the treatment. Nevertheless, the control measures must be accompanied by hygienic and sanitary improvements, such as the isolation of affected birds, improvement in ventilation and nutrition, avoidance of over-crowding, disinfection of food and water containers and so on.

In recent years a number of different specific infections have been identified, many of which have features in common. These diseases can be caused by viruses, bacteria, parasites, or even deficient diets and it is obvious that the use of one general term such as "roup" is obsolete and it is equally absurd to expect general recommendations to be effective. For example, a vaccine prepared against a virus disease such as fowl pox cannot possibly immunise against a bacterial infection. Neither can any therapeutic substance such as a sulphonamide overcome a disease which might be due to a vitamin deficiency.

It will be obvious that the first step is to be able to differentiate the conditions before specific recommendations can be made. Unfortunately, the subject is further confused by the fact that some of these diseases do not always occur in one typical form. For example, Newcastle disease may affect the respiratory tract but may on other occasions give rise to nervous symptoms. Furthermore, in some outbreaks the

picture is confused by the co-existence of two infections in the same flock. Fowl pox or tracheitis may sometimes be superimposed on coryza and the infectious bronchitis virus has been isolated from flocks affected with Newcastle disease, while vitamin-A deficiency often occurs associated with fowl pox or even coryza.

In an attempt to simplify the matter we can divide the diseases of the respiratory tract into the following main types. (1) Those caused by viruses, i.e., infective agents capable of passing through filters and invisible by the ordinary microscope—fowl pox, infectious laryngotracheitis, Newcastle disease, infectious bronchitis, sinusitis in turkeys, psittacosis (ornithosis), and a form of coryza possibly associated with a virus. (2) Those caused by bacteria—infectious coryza (H. gallinarum infection), cocco-bacilliform coryza or chronic respiratory disease, B.W.D. (pullorum disease), and chronic fowl cholera. (3) Diseases caused by fungi-aspergillosis. (4) Nutritional deficiencies—nutritional roup or vitamin-A deficiency. (5) Animal parasites—gape worm. (6) Mechanical agents and tumours—obstructions.

Respiratory diseases are extremely complex. A total of some ten diseases may be capable of giving rise to nearly indistinguishable symptoms. Many of these, however, can be fairly readily differentiated in the laboratory, particularly if there is close co-operation between the pathologist, the field officer and the farmer, so that the whole pathological and clinical picture can be seen together. From the poultryman's angle it may have been simpler when all diseases of this type were known by the one title 'roup' and I am sure you will agree with me that the sub-division of these diseases is a tremendous step in the right direction, especially if preventive treatment by vaccines or curative treatment by drugs is to be used. Since these are seldom effective against more than one condition, it is obvious that a definite diagnosis must, if possible, be arrived at.

Finally, I would again stress the point that the environmental conditions inevitably predispose towards the occurrence, rapidity of spread and severity of respiratory conditions and that these conditions are likely to become commoner under intensive methods, where there is close contact and spread from bird to bird by a dust laden atmosphere. Sound husbandry methods, good nutrition and a high standard of hygiene are probably the best preventions of respiratory diseases and even once an outbreak has started, can help considerably in eliminating the spread of infection.

RESPIRATORY DISEASES

Cause	Name	Incubation Period	Duration	Spread	Mortality	Nasal Discharge	Facial Swelling	Tracheal Lesions	Breathing	Other Symptoms	Carriers	Diagnosis	Prevention or Treatment
I. Virus	Fowl Pox	7-14 days	3-4 weeks	Slow	Variable but low	Seldom	Seldom	Rare	Normal	Warts face, wattles, comb. Membranes mouth and tongue.	No	Clinically or inoculation of chick embryos or susceptible fowls	Pigeon pox virus or fowl pox virus vaccine by scarification or stick meth.
	Infectious Laryngo tracheitis	4-21 days	Variable	Rapid	High or slight if acute or mild.	None	None	Blood, blood clots or necrotic casts.	Coughing, rattling, and outstretched head and neck.	Coughing of blood.	Yes over year	Clinically or by chick embryo or susceptible fowl inoculation	Vaccine (in U.S.A.) applied to cloaca.
	Newcastle Disease	5-7 days	Few days	Rapid	High or slight if acute or mild.	Slight to profuse	None	None	Coughing, sneezing.	Nervous. Drop in egg yield and diarrhea.	Probably not.	H.I. test egg inoculation or susceptible fowl.	Notifiable in Great Britain, vaccines in other countries.
	Infectious Bronchitis	18-24 hours	10-14 days	Rapid	Chicks high; adults low.	Slight to profuse	None	None	Sneezing and difficult breathing, crackling.	Drop in egg yield	Yes	Egg inoculation. Very difficult.	Vaccine in U.S.A.
	Sinusitis in turkeys			Rapid	Variable	Profuse	Severe	None	Sneezing and difficult breathing	Emaciation	Yes	Clinically	Streptomycin intramuscular and into sinus. Silver Nitrate.
II. Bacteria	Infectious Coryza	24-48 hours	10-14 days	Rapid	Slight	Profuse	Slight to severe	None	Sneezing, head shaking.	Drop in egg yield. Loss of condition.	Yes	Clinically, smears and cultures.	Sulphathiazole. Improved husbandry.
	Chronic Respiratory Disease	10-20 days	Months	Slow	Variable, low to high	Profuse	Severe	None	Sneezing, coughing, and rattling.	Loss of condition. Drop in egg yield.	Yes	Clinically and cultures.	Streptomycin intramuscular.
	B.W.D.	3-7 days	Few days	Rapid	High	No	No	No	Laboured	Diarrhea	Yes	Culture	Blood testing.
III. Fungus	Aspergillosis	2-4 days	Few days	Rapid	Variable to high	No	No	No	Laboured	——	None	Culture	Remove cause.
IV. Dietary	Avitaminosis-A (Nutritional Roup)	——	——	——	Low	Yes	Yes	Yes	Laboured	Pustules in gullet	——	Clinically	Adequate vitamin A.

FANS FOR POULTRY HOUSE VENTILATION

H. N. COLBY

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Broiler growers are becoming more interested in fan ventilation for their poultry houses not only as a means of controlling moisture in the litter, but to aid in the control of respiratory diseases brought out by foul, ammonia-laden air.

Broiler houses are more likely to present ventilation problems because they are often crowded, particularly after the broilers reach the age of six to eight weeks.

While the following suggestions are not guaranteed to produce perfect results, following them will alleviate the worst conditions often found in broiler houses.

1. Install an exhaust type ventilating fan (or fans) in the rear wall of the house or on the coldest side of a north-south running house.

2. Install them as high as practicable in the wall, near the ceiling, or in the upper half of existing windows.

3. Provide 2/3 of a cubic foot of air per minute fan capacity for each square foot of floor area. In pens larger than 40 feet square two small fans will provide better ventilation than one large fan.

4. Provide a hood and louvers on the outside wall to eliminate back-draft when the fan is not running.

5. Use a thermostatic switch which may be set for any desired room temperature so the fan will stop running in the event of a sharp drop in temperature.

6. While fans are in operation keep all openings in that wall closed. Make the air travel across the pens from windows opened slightly in the wall opposite the fans.

7. Some poultrymen also build a chute or flue enclosing the fan, running the bottom of the flue to within about a foot of the litter and providing a door or gate directly in back of the fan so it can be opened downward when more air movement near the ceiling is desired. With the door in the flue closed, the volume of air removed is reduced about 1/3, and it is taken from about floor level.

8. Ventilation does not generally present a problem until the chicks are a month old, at which time the fans can be operated without fear of creating draft enough to do any harm. (New Hampshire Poultry Department "Combings.")

HEATING POULTRY DRINKING WATER

ELECTRICALLY HEATING POULTRY WATERING SYSTEMS BY DIFFERENT METHODS TESTED FOR ECONOMY OF OPERATION.

JOHN B. DOBIE and LEROY C. KLEIST
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Tests on three methods of heating poultry watering systems electrically indicated that it was most economical to run the heating cable through the water pipe.

The method of heating the water by spiralling electric heating cable around the pipe is common practice in many areas but, in addition to being less economical, it has the disadvantage of requiring mechanical protection for the cable from the birds.

The method of using the pipe itself as a heating element necessitates considerable electrical know-how plus the investment of a fairly heavy duty transformer. All pipe joints must have a good electrical connection and the system, although operated at low voltage, is not insulated and therefore hazardous as a source of electric shock. This system is quite economical in the use of power but requires a greater capital investment.

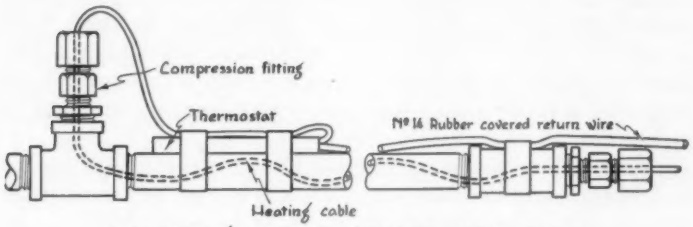
The third method tested involves running the electric heating cable through the water pipe.

Inexpensive connectors are available for making a drip-proof connection for running the electric heating cable through the inside of the pipe—on either standard or low pressure systems. The cable is small, about ⅛″ in diameter and thus does not reduce the carrying capacity of the pipe materially. Encasing the wire in the pipe protects it from mechanical injury. The cable insulation is suitable for use when immersed in

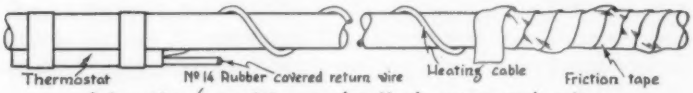
Under conditions of natural convection and temperature

	Watts per foot per °F below 32	Watts per 100 feet run for 15° F temp.
Cable through pipe		
½″ pipe	0.07	110
¾″ pipe	0.10	170
Cable spiralled around pipe		
½″ pipe	0.17	289
¾″ pipe	0.20	340
Pipe as heating element		
½″ pipe	0.12	204

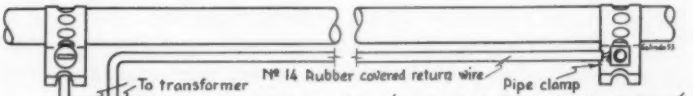
range of 0°F to 32°F, the amounts of connected load required in these tests to keep the pipes from freezing were:
water. The pipe may be grounded to protect the poultry from shock in case of a breakdown in insulation. This system is low in insulation cost and power consumption.



Heating cable inside the pipe



Heating cable spiralled around pipe



Pipe used as heating element — low voltage

The problem of protecting poultry waterers from freezing is confined mainly to areas where a minimum temperature of 20°F or less may be expected.

Open type laying houses now in use in many colder areas afford little protection from freezing of the long runs of water pipe required, particularly since the nests and pipes are normally three or four feet above the ground.

Drip-type waterers are particularly susceptible to freezing because of the very low flow rate through the pipes and the drip fountains.

Frozen waterpipes, in addition to being a nuisance, may reduce egg production. When water is not available, birds stop eating and as a result, lower egg production may be expected. (California Agriculture).

FORMALDEHYDE FUMIGATION IN HATCHERIES

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Egg incubators are so constructed that it is practically impossible to do a thorough job of disinfecting them with liquid disinfectants. Gases are much more effective for this purpose. Since formaldehyde can be readily released from formalin, a fairly stable solution, it is a popular fumigant in hatcheries.

The killing power of formaldehyde for bacteria is higher in a warm, humid atmosphere than it is in cool, dry conditions. Therefore, it requires less formalin to properly fumigate an incubator at operating conditions than would be required to fumigate the same machine after it has been allowed to cool and the water vapour disperse. Fumigation at operating conditions saves time,—a very important item in hatchery operation.

Despite all that was known regarding formaldehyde as a fumigant, no organized plan for evaluating the efficiency of fumigation practices in hatcheries was conducted in this country until this past decade. However, most manufacturers have recommended fumigation procedures for their types of incubators. A review of these recommendations showed that they varied from 0.25 c.c. to 2.5 c.c. of formalin per cubic foot capacity to kill *Salmonella pullorum* bacteria. In addition, some of these recommendations did not specify any particular temperature, humidity, or exposure at which to conduct fumigation even though earlier experiments stressed the importance of all these factors.

The poultry authorities in Ontario became concerned over the diversity of recommendations and specifications for hatchery fumigation with formaldehyde. In 1941, the Departments of Bacteriology and Poultry, Ontario Agricultural College, were asked to investigate the fumigation procedures of some commercial hatcheries in order to determine the efficiency of their methods. In most instances, hatcherymen were unaware of the part played by temperature, humidity, or time in this fumigation procedure. Hence, it was common to find that the amount of formalin used was not sufficient to produce a concentration of formaldehyde which would kill pullorum bacteria under the conditions at which the fumigation was conducted.

The efficiency of a particular fumigation procedure was determined by placing crushed egg shells contaminated with *Salmonella pullorum* bacteria in several locations in a machine during the actual fumigation. It was necessary to place cultures in the top and bottom corners as well as the middle of an incubator in order to get a true determination on all types of machines. This entails a considerable number of cultures but for preliminary investigation the results are worth while and very informative insofar as variations among incubators occur. The exposure of sterile selective culture media in petri dishes did not give results that were comparable to the exposure of the inoculated egg shell.

Whenever it was necessary to change the fumigation procedure at a hatchery the operators did not want to increase the exposure time. In fact, some hatchery operators begrudged the time devoted to fumigation in an already busy programme. With this in mind, basic recommendations were formulated around a fumigation procedure that could be carried out in twenty minutes. To add uniformity to these recommendations, they were designed for incubators that were operating at a dry bulb reading of 97-99°F and a wet bulb reading of 86°F or higher.

Formaldehyde may be released from formalin either by evaporation of the solvent, which in this case is water, or by chemical methods. The former method is accomplished by taking up the required amount of formalin on cheesecloth and hanging it inside the incubator. This method is not suitable for incubators which ventilate by gravity because evaporation is not rapid enough to produce a bactericidal concentration of formaldehyde. The chemical method of liberation of formaldehyde is suitable to all types of machines. The correct amount of formalin is poured onto an amount of potassium permanganate sufficient to produce enough heat to liberate the formaldehyde rapidly. Since this reaction is rapid, it should be carried out in a container with sloping sides to prevent the contents from overflowing. An enamel or earthenware vessel is quite satisfactory. In incubators having forced air circulation, the reaction vessel is placed in the line of air movement which is usually the fan compartment.

The automatic controls of each incubator should be fastened in the closed position during the fumigation procedure. The compartments which ventilate by gravity will have an opening usually at the back near the bottom. It is not convenient to close these because they are usually not

readily accessible. For these incubators the fumigant is increased to compensate for the loss through this opening. At the end of the fumigation time, all the controls should be returned to the automatic position.

The temperature of an incubator may go up from one-half to one degree during the fumigation procedure depending on the size, type, and condition of the incubator. Nevertheless, to maintain a uniform temperature and to facilitate even distribution of the fumigant, the fan should be left running during the fumigation procedure.

The amount of formalin and potassium permanganate required to fumigate an incubator will depend on three things, —temperature, humidity, and time of exposure. Most hatchery operators prefer a fumigation procedure that requires a short exposure time. Therefore, recommendations in Ontario have been based on an exposure time of twenty minutes. Since the efficiency of the fumigant is higher at a high temperature and a high humidity, the recommendations were adapted to these conditions. For incubators employing forced-air circulation, the basic recommendation is one and one-half cubic centimeters of formalin and one gram of potassium permanganate per cubic foot of volume. The volume of the eggs is disregarded. The same amount of formalin is used when the cheesecloth method is employed. Incubators which ventilate by gravity require two and one-half cubic centimeters of formalin and one and eight-tenths grams of potassium permanganate per cubic foot. These recommendations are only basic and therefore have to be changed if microbiological examination of fumigated chick down and egg shell indicates the presence of bacteria that are normally killed by a concentration of formaldehyde that will kill the pullorum bacteria.

From the former method of checking the efficiency of hatchery fumigation, our present method evolved whereby the service was extended to all the hatcheries in Ontario. The service is on a voluntary basis and any hatchery wishing to co-operate supplies the technical data regarding his machines and methods of fumigation. Samples of refuse from a hatch, chick down and egg shell, are submited for bacteriological examination. Sterile capsule vials each containing a piece of wood to facilitate sampling are supplied by the laboratory. Samples are collected from each incubator before and after fumigation. The fumigated sample is examined by bacterial culture on selective media. If micro-organisms are recovered from this sample, the sample which was taken before fumi-

gation is spread in a dish, fumigated, and cultured. Fumigation of samples at the laboratory is carried out in a small-scale model of a popular incubator. Basic amounts and operating conditions are employed with an exposure time of twenty minutes.

The information obtained from the examination of hatchery refuse that has been fumigated is generally sufficient to advise the hatchery operator by letter how to improve the efficiency of his fumigation program if necessary. This allows for a wider application of this service than was possible when samples of contaminated egg shell were taken to the hatcheries and exposed.

In some hatcheries, eggs are placed in an incubator until about three days before hatching when they are moved to a second machine adapted for hatching. The former is called a setter and the latter a hatcher. It is not the intention here to discuss the sanitation of the placement of these machines in the hatchery building. However, we have not recovered *S. pullorum* bacteria from a setter unless the conditions were very unsanitary and hatching was occuring in this machine. Therefore, we have been recommending the fumigation of setters only on special occasions of necessity. When setters are fumigated, no embyros between twenty-four and eighty-four hours' incubation should be exposed to a bactericidal concentration of formaldehyde. We recommend that our hatcherymen fumigate hatchers two times for every hatch. They should be fumigated when the eggs are placed in them from the setter. This renders the atmosphere safe for chicks to hatch by killing disease producing bacteria on the eggs that may have been transmitted from the previous hatch. Hatchers should be fumigated again after the hatch has been taken off.

Some hatcherymen have machines which are adapted to incubate and hatch in the same compartment. These are sometimes referred to as combination machines. When such machines are fumigated, the precautions mentioned for individual setters should be followed. Sometimes, however, it is more convenient to remove trays containing embryos between 24 and 84 hours' incubation from the machine during the fumigation period. They should not be returned to the machine until the formaldehyde has been dispersed or neutralized.

We do not recommend the fumigation of chicks with a concentration of formaldehyde that is bactericidal on twenty minutes' exposure. By fumigating after the hatch has been taken off, the exposed parts of the refuse are rendered safe

to handle and dump without needlessly contaminating the atmosphere in the hatchery. Nevertheless fumigated hatchery refuse should be disposed of in a manner to prevent any subsequent contact with poultry because cull chicks, dead-in-shell embyros, and infertile eggs are not sterilized by fumigation.

The information given in this paper applies to the operation of chick hatcheries. However, unpublished data indicate that turkey embryos are not harmed by a bactericidal concentration of formaldehyde during the last week of incubation.

REFERENCES

Bittenbender, H. A. 1939. Incubator Fumigation. Address delivered at 1939 Poultry Improvement Plan Conference, Cleveland, Ohio.

Bushnell, L. D., L. P. Payne, and C. J. Coon. 1929. Fumigation of Forced-draft Incubators. *Am. Vet. Med. Assoc. Jour. 75:* 611-625.

Cunningham, J. D. and D. R. McLaughlin. 1953. unpublished data. Ontario Agricultural College, Guelph, Canada.

Gwatkin, R. 1926. Some experiments on the Disinfection of Eggs in Incubators, Ontario Veterinary College Report for 1926, pp. 58-65.

Insko, Jr. W. M., G. Steele Dewey, and Cecil M. Hinton. 1941. Effect of Formaldehyde Fumigation on Mortality of Chick Embryos. *Ken. Agric. Exp. Sta., Bull. 416.*

Marcellus, F. N., R. Gwatkin, and J. S. Glover. 1931. Incubator Disinfection in the Control of Salmonella Pullorum. *Report of Proc. of Fourth World's Poultry Congress, 1930,* pp. 401-408.

Pernot, E. F. 1909. An Investigation of the Mortality of Incubator Chicks. *Oregon Agric. Exp. Sta. Bull. 103.*

Wright, M. L., E. H. Garrard, and F. N. Marcellus. 1944. A Plan to Control Transmission of Salmonella Pullorum in Hatcheries. *Can. Poult Rev.* Dec., 1944.

BLUE COMB IN CHICKENS

Blue Comb is a pathological complex resembling shock in the early phase, with enteritis apparent in less acute cases. Accumulated data from field outbreaks in Florida indicate that climatic stress might be a contributing factor in the incidence of this disease of poultry. A maximum temperature exceeding 85 F. was found to occur three or four days before cases were presented to the laboratory for diagnosis. By this time, enough losses had occurred to be brought to the attention of flock owners.

Diagnostic laboratories in New England also have made observations on the influence of weather on the incidence of this poultry disease. Five laboratories received, during a two-day period in 1951, more than 71 cases after temperatures of 78 F. or over were recorded. A prediction made in 1952 confirmed earlier results of studies. Highest incidence occurred during the hot months of summer. (Veterinary Medicine)

VIABILITY IN INTER-STRAIN CROSSES

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Since most poultry breeders are vitally interested in breeding for viability, a report in November, 1953 *Poultry Science* titled, "Influence of Heterosis and Maternal Effects on Viability in an Inter-Strain Cross of White Leghorns" by F. Moultrie, D. F. King and G. J. Cottier appeared worthy of review. These workers conducted systematic crosses of two strains of Leghorns involved in viability studies at the Alabama station. Strain A was characterized by high viability and Strain D with a relatively lower viability. Table I briefly summarizes the results of these crosses.

TABLE I

Mortality of Females 1 Through 155 and 156 to 520 Days of Age, Respectively

Year	Pure Strain A % Mortality		Strain D % Mortality		A male x D female % Mortality		D male x A female % Mortality	
	1-155	156-520	1-155	156-520	1-155	156-520	1-155	156-520
1949	16.1	16.4	27.8	32.7	—	—	14.1	16.9
1950	24.9	14.0	23.7	31.1	39.4	29.8	16.9	17.8
1951	11.6	17.4	13.9	29.7	—	—	8.7	16.5
Ave. (1949-50)	16.7	16.2	21.1	30.8	39.4	29.8	12.4	16.9

Moultrie et al. considered the above results to indicate heterosis for viability and also a possible maternal effect. The basis of the maternal effect was the pronounced difference in mortality between the reciprocal hybrids produced in one year, 1950. These results are possibly indicative but will require further substantiation. Previous studies on viability have not revealed any pronounced maternal effects.

As for the heterosis resulting from these crosses, it is somewhat dependent on the definition used for heterosis. In the case of viability from 1 to 155 days of age, there is some evidence of hybrid superiority over either parent. As for adult mortality, the inter-strain hybrids were equal in viability to the superior parental line. This result is especially encouraging as it indicates further possibilities in the economic utilization of high viability strains. (Featheredfax)

GROWERS CAN CUT TURKEY DISEASES

Turkey disease losses can be cut substantially by ounce-of-prevention methods.

ARS poultry pathologist J. E. Williams says turkey growers should follow these five general practices to guard against disease in their flocks: (1) buy poults from a reputable hatchery; (2) use sound management; (3) follow a good feeding program; (4) practice strict sanitation; and (5) watch the flock constantly.

Williams also recommends that growers use diagnostic services now available in many States, if they suspect a disease outbreak. With a few live birds to examine, knowledge of early symptons, mortality, rate of onset, treatment, feed, and other factors, laboratory workers can often check a dangerous infection.

Salmonella infections, such as pullorum, typhoid, and paratyphoid, and the paracolon infections are high on the list of diseases that concern turkey growers. Vigilance and sanitation keep these diseases away.

Symptoms and post-mortem lesions in both groups are similar. All may be egg-borne, and diagnosis takes laboratory tests. Typhoid carriers may be detected by pullorum tests, as may some carriers of paratyphoid and paracolon infection (testing for the latter is limited). They occur widely in nature, but pullorum and typhoid carriers are usually found only in chickens and a few other fowl.

Control begins with the purchase of disease-free stock. When infection is found, however, general blood-testing should be undertaken and reactors removed. Frequently, paratyphoid-infected flocks should be destroyed. Treatments aren't entirely satisfactory. Losses may be cut by sulfa drugs, but results indicate a need for some further study.

Blackhead is an old disease of turkeys and long the bane of growers. Caused by a parasitic organism that thrives in the intestinal tract, blackhead spreads from bird to bird through droppings. It was originally a disease of chickens, which have developed fair resistance but are still carriers. Parasite eggs may survive for years in cecal worms or cecal-worm eggs of the chicken, and no known chemical kills the eggs in soil once a range is contaminated.

Because turkeys are so susceptible to blackhead, they should never be raised with chickens. Control is best achieved by range rotation. Phenothiazine (½ gram per poult, 1 gram per adult) eliminates adult cecal worms from turkeys and

chickens.

When blackhead is a constant problem, a grower should consider continuous use of drug preparations that retard this disease. Close watch should be kept to see that water consumption stays up to normal.

Coccidiosis, trichomoniasis, and hexamitiasis are found frequently in certain parts of the country. Like blackhead, these are caused by parasites and may be prevented and treated in much the same way.

Bluecomb, cause of which is still unknown, appeared in Minnesota turkeys in 1951. It's also called mud fever, nonspecific enteritis, and pullet disease. Research at the University of Minnesota indicates the disease may be contagious.

Bluecomb appears in both acute and chronic forms. The former causes losses that continue for about 10 days after affected birds stop eating and drinking and develop a diarrhea. Heads and flesh turn dark blue. In the chronic forms, symptoms don't appear so early and there's less drop in feed and water intake.

Since there are no thoroughly tested treatments, preventive measures are still the best means of control. Encouraging results have been obtained in infected flocks, however, by use of molasses at the rate of 1 pound to 5 or 6 gallons of water, and Epsom salts at the rate of 1 pound to 4 or 5 gallons of water. The medicated water is used a half-day, then plenty of fresh water is provided.

Erysipelas, a bacterial disease of turkeys, for the most part affects market-age birds, especially males. Toms are affected more than hens because skin injuries from fighting allow the organisms to get in.

Debeaking and desnooding may help prevent erysipelas, but these practices need considerable field testing before they can be recommended. Two satisfactory methods of treatment are the use of penicillin and erysipelas antiserum. Vaccination results are fairly encouraging, but little is known about its duration. This treatment should be done before there's any evidence of the disease.

Infectious sinusitis, a respiratory infection, is caused by a virus-like agent strongly suspected of being the same that causes the still mysterious airsac of chickens. In turkeys, symptoms include nasal discharge, swollen sinuses, labored breathing, and coughing. Streptomycin and other antibiotics are used to treat this disease and its respiratory forms. (Agrisearch Notes, U. S. Dept. Agr., Washington, D. C.)

WORLD'S POULTRY SCIENCE LIBRARY

Reviewer:
W. D. TERMOHLEN

United States Department of Agriculture
Washington, D.C., U.S.A.

Note: W. D. Termohlen, Honorary Past President, has consented to succeed the late Professor W. C. Thompson as Reviewer of the Library Section of the World's Poultry Science Journal.

In this section will appear brief reviews of books of interest to poultrymen everywhere. Included in these will be notations concerning highly technical books as well as practical treatises on poultry production problems. From time to time as newly revised editions of standard poultry books appear, mention will be made of them. The editor of this section will appreciate receiving or being advised of the appearance of new books in any of the countries served by the World's Poultry Science Association.

PRACTICAL POULTRY BREEDING—1951—Don C. Warren—Published by The Macmillan Company, New York City—$4.50.

This is a book which is easily read, very understandably written by an author with many years of experience in poultry breeding. Don C. Warren, the author, is a graduate of Indiana and Columbia Universities. For many years, he was a Professor of Poultry Breeding at Kansas State College where he taught, carried on valuable research, and made practical application of research results. In recent years, he has served as the National Coordinator of Regional Poultry Breeding Projects for the United States Department of Agriculture at Purdue University.

Breeders of poultry and students, who are getting an introduction to the field of breeding, will find this book invaluable. It should be considered a must on their library shelf. Hatcherymen; marketing people, who have contact with producers; commercial feed men; as well as teachers, and extension workers will find it an every day useful tool.

The 242 pages of this book contain 15 fact-packed and understandable chapters, and a glossary defining 88 terms rather commonly used in connection with poultry breeding.

The first two chapters cover, briefly, the History of Poultry Breeding and a fine summarization of Elementary Genetics. Objectives of Breeding and Reproductive Problems are the subjects of the next two chapters. The next 9 chapters are packed full of an up-to-date analysis and description of procedures, techniques, and systems used in the actual practical application of poultry breeding. Sources of Information on Breeding Stock and Plans for a Breeding House complete the chapters.

The author points out in the preface that a considerable change has taken place in the past few years in the viewpoint of professional poultry breeders. He further states this shift has been so recent that some disagreement persists. He has purposely, therefore, kept the controversial material to a minimum. It is pointed out that the early poultry breeder gave major emphasis to individual merit in the selection of his breeding birds. Recently professional breeders have given more attention to family selection and progeny testing. It is suggested that the use of family breeding may have been over emphasized. It is recommended that the use of family breeding be restricted to traits of lower heritability. For other characteristics, selection on an individual merit may be more effective. The newer techniques of poultry breeding designed to take advantage of hybrid vigor are covered in Chapter 12. A statement of the author with respect to hybrids is worth quoting. "The challenge of hybrids to the well-established purebred poultry is a stimulating one which comes at a time when the industry was becoming too self-satisfied and willing to accept stocks in their present state of improvement. Regardless of the outcome of the competition, the end results will be in the direction of increased productivity." Methods such as crossbreeding, inbreeding and recurrent reciprocal selection are explained. Artificial insemination is described and it is pointed out that a poultryman attempting to do a good job of breeding cannot afford to be unfamiliar with this technique. The various methods of sex distinction at the time of hatching are briefly but fully described in Chapter 13.

The basic and principle purpose of poultry breeding is the adapting of the chicken or other type of poultry to man's needs. This means development of characteristics which will make for more economical production for the producer and an end product desired by consumers and available at as economical price as possible. Breeding for the improvement of thirteen different economic traits is covered in chapter 10. The putting together of these factors in one chapter is a timely innovation and, for any person interested in the poultry industry, this one chapter alone is worth the price of the book.

Supplementing the text and explaining procedures are 18 tables and 66 illustrations.

Again may your reviewer report—this is a book which will be useful to every person interested in the poultry industry.

AVIAN PHYSIOLOGY—1954—Paul D. Sturkie—Published by Comstock Publishing Associates, a Division of Cornell University Press, Ithaca, New York—$6.00

Poultry husbandry scientists and investigators of physiology, zoology, animal husbandry, and veterinary medicine, will find this book of interest and undoubtedly very useful. This is the first book in any language devoted to the specialized physiology of birds. The book stresses the physiology of the chicken, turkey, duck, and pigeon, since these are the birds on which most research in physiology has been done. Also, these birds are the ones which have made an increasing contribution to the economic welfare of mankind.

The book covers 443 pages, consisting of 21 chapters and a 10-page index. There are numerous tables and illustrations. At the end of each chapter will be found a bibliography, a convenient and most useful method. The author states that the bibliography is extensive, but not exhaustive, and that an attempt was made to select the most important and more recent references. In spite of this modesty, we find there are just over 1,000 references cited, though, in some instances, the same book, bulletin, or article may be repeated several times. Your reviewer feels it safe to say that in this book will be found the most recent, pertinent, and well-summarized knowledge on Avian Physiology to be found any place. The various chapters cover information on blood, circulation, heart, respiration, body temperature, energy and carbohydrate metabolism, the alimentary canal and digestion, kidneys and urine, sense organs, reproduction in the female and male, hypophysis or pituitary, hormones, thyroids, parathyroids, thymus, pancreas and adrenals.

The author, Paul D. Sturkie, is Professor of Poultry Physiology, Rutgers University, located at New Brunswick, New Jersey. During the last 8 years, he has authored numerous articles reporting research on physiology phases. These reports have appeared in such scientific journals as Poultry Science, American Journal of Physiology, Endocrinology, Journal of Experimental Zoology. By experience and accomplishment, he was well qualified to write this first complete book on Avian Physiology. This is the sort of technical book which specialized poultry students will find very useful as a reference text. It should be available at every experiment station for the use of research workers. It is a valuable addition to poultry science literature.

REVIEW OF POULTRY PUBLICATIONS

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GENETICS

COCK, A. G.

THE INTERPRETATION OF AUTOSEXING. *Jour. Genetics 51:* 421-433. Illus. 1953.—Autosexing breeds of fowl may be divided into those which carry the sex-linked gene for barring (B), and those which do not. In the former group, the autosexing properties are due to the imperfect dominance of B. A table is presented showing the possible dominance relations between a sex-linked gene which is a hypomorph, hypermorph, antimorph, amorph or neomorph, and its wild-type allele, both without dosage compensation, and in conditions of partial and full dosage compensation. (Biological Abstracts)

HORN, A., V. GERENCSER, and G. S. TOTH. (Univ. Agric., Godollo, Hungary.)

A HIGHLY PRODUCTIVE HYBRID DUCK. *World's Poultry Sci. Jour. 9:* 264-265. 1953.—Hungarian ducks (Peking type) crossed with the Muscovy exceed the Hungarian whites in growth, consumption of grass, tolerance of stuffing, dressing percentage, and fat liver size and quality (68.8% fat).—*J. B. Christiansen.* (Biological Abstracts)

HUTT, F. B. (Cornell U., Ithaca, N. Y.)

ON CROSSING-OVER AND SEX IN THE FOWL. *Amer. Nat. 87:* 393-394. 1953.—To refute the claim of Fisher and Landauer that the sexes differ significantly in the amt. of crossing-over between creeper and rose comb, it is shown that the variability in published measures of the linkage is too great to permit much reliance on statistical constants derived from the lumped data. The difference between sexes is less than that for females only in Landauer's data for 2 successive years. The Cp mutation is difficult to classify in embryos. Since a single error in 200 could double the normal amt. of crossing-over, the Cp-R pair is considered unsuitable for measuring sex differences in crossing-over. Other linkage groups show no difference.—*F. B. Hutt.* (Biological Abstracts)

JEFFREY, F. P., T. W. FOX, and J. R. SMYTH, JR. (U. Massachusetts, Amherst.)

OBSERVATIONS ON DOUBLE-YOLKED EGGS FROM THE DOMESTIC FOWL. *Jour. Heredity 44:* 213-216. 1953.—A description of 2 viable chicks hatched from a double-yolked egg is given. The fact that one chick was a male and the other a female is proof that the chicks were not monovular twins. Both chicks were alive at 19 days of age when sacrificed. Exterior traits as well as stages of development reached in incubated double-yolked and single-yolked eggs are compared. There is some indication that the tendency to produce double-yolked eggs might be hereditary.—*F. P. Jeffrey.* (Biological Abstracts)

MATEJICKOVA, O. (Czechoslovakia)

HETEROSIS OF POULTRY IN OUR COUNTRY. [UZITKOVE KRIZENI DRUBEZE U NAS]. *Drubeznictvi, 1953, I, 5:* 91-93.—Experiments were done with crossing the Rhode Island Red, Brown Leghorn and Wyandottes in combination. The first generation after crossing nearly

in all combination has better fertility, hatchability, more chickens from eggs put into the incubator, better livability of chickens after hatching up to 14 weeks, higher increase in weight and better quality of slaughtered poultry. *(V. Orel.)*

MOULTRIE, FRED, D. F. KING, and G. J. COTTIER. (Alabama Polytech. Inst., Auburn.)
INFLUENCE OF HETEROSIS AND MATERNAL EFFECTS ON VIABILITY IN AN INTER-STRAIN CROSS OF WHITE LEGHORNS. *Poultry Sci. 32:* 935-941. 1953.—In 3 successive yrs., crosses were made between two noninbred strains of Single Comb White Leghorns differing significantly (signif.) in adult livability. Crosses were made in 2 of the yrs. by mating sires of the relatively susceptible (suscep.) strain with dams of the resistant (resis.) strain; in the 3d yr., reciprocal crosses were made. The F_1 inter-strain hybrid pullets produced by suscep. sires and resis. dams consistently showed evidence of heterosis in viability (viab.) during both the growing and laying periods. In 1 yr. in which reciprocal crosses were made, the F_1 interstrain hybrid pullets produced by resis. sires and suscep. dams exhibited no evidence of heterosis in viab., but died in both the growing and laying periods at rates signif. higher than did birds produced by the reciprocal cross. In no instance did adult mortality of the F_1 inter-strain hybrids differ signif. from adult mortality of the female line used to produce the hybrids. It is evident from the data presented that in hybrids of the 2 strains maternal effects and possibly heterosis play important roles in determining viab.—*Fred Moultrie.* (Biological Abstracts)

NORDSKOG, A. W., and OWEN COTTERILL. (Iowa State Coll., Ames.)
BREEDING FOR EGG QUALITY. 2. SAMPLING HENS FOR INTERIOR QUALITY. *Poultry Sci. 32:* 1051-1054. 1953.—Repeatability estimates for albumin height and Haugh units based on 497 eggs collected from hens of several breeds averaged 0.75. Repeatability is defined as the correlation between observations on eggs laid by the same hen. Calculations show that when the repeatability value is this high, the genetic improvement possible by selecting hens from observations based on 1, 2, and 3 eggs is 87, 91, and 93%, resp., of the max. possible. —*A. W. Nordskog.* (Biological Abstracts)

OLSSON, NILS. (The Agricultural University, Uppsala, Sweden.)
KORSNINGS-OCH UPPFODNINGSFORSOK MED GASS [CROSS BREEDING AND RAISING OF GEESE]. Kungl. Lantbrukshogskolan och Statens Lantbruksforsok, Statens Husdjurstorsok, Meddelande nr. 53. 1953.—In 1945-50 breeding experiments on geese were carried out at the National Animal Experiment Station, Uppsala 7 (Sweden). The main results of these experiments are:

1. The mean egg production of the breeding geese during the season up to June 15 was as an average for the Scanian goose 20.8, Toulouse goose 32.2 and Roman goose 36.4 eggs. Hybrids of Scanian goose, male, resp. Roman and Toulouse goose, female, have during the same time as an average laid 36.7 resp. 30.6 eggs. Hybrids of Toulouse goose, male, and Roman goose, female, had an egg production of 35.5 eggs.

2. The fertility percentage of the eggs was on an average for Scanian goose 33.3, for Toulouse goose and Roman goose between 70 and 90. The hatchability percentage of the fertile eggs was for Scanian goose 29.8, for Touluse goose 41.3 and Roman goose 68.6.

3. The gain in weight of the goslings was highest at ages between 2 and 9 weeks, while their gain in weight before and after these ages was more slowly. The mean weights of the hybrids in different ages were in general intermediate to the weights of the pure breds, from which they arrived. In some cases the mean weights of the hybrids were quite near the weight of that parent breed having the higher weight. Hybrids of Scanian goose resp., Toulouse goose, males, and Roman goose, females, had a high growth rate and were very well fit for goose breeding in practice. In this cross breed the high egg production and high fertility and hatchability of the eggs in the Roman goose can be utilized.

4. During a fattening period of 5-6 weeks the geese had a gain in weight of 1.88 kg corresponding to 37.5 per cent of the weight when the fattening was started.

5. The decrease in weight of the geese carcases, as a consequence of special procedures at slaughter (blood-letting and dressing), was on an average of 11.9 per cent of their live weight.

6. The requirement of cereals (oats) during the fattening period was 20 kg per goose or 10.63 kg per kg gain in weight.

7. The Roman goose has a sex-linked feather colour inhibitor, which dominates over the feather colour of the Scanian goose and dilutes the feather colour of the Toulouse goose.

8. The gray feather colour of the Tulouse goose is determined by an autsomal gene, which in the absence of the above mentioned feather colour inhibitor dominates over the feather colour of the Scanian goose. —*An abstract.*

ROBERTS, E., and C. D. MUELLER. (U. Illinois, Urbana.)
HOMOLOGOUS MUTATIONS AFFECTING EYE COLOR IN WHITE PLYMOUTH ROCKS. *Jour. Heredity 44:* 194. 1954.—Crosses between "red-eye" and "pink-eye" stocks indicate that the eye colors in both stocks, although different in appearance, are caused by the same gene.—*L. M. Dickerson.* (Biological Abstracts)

SHULTZ, FRED T. (U. California, Berkeley.)
ANALYSIS OF EGG SHAPE OF CHICKENS. *Biometrics 9:* 336-353. 1953.—Egg shapes for 1st and second position eggs of 2 clutches from 786 pullets were measured and treated by analysis of variance and covariance. Represented were the U. of California production-bred, flock, 8 inbred lines and crosses between the inbred lines. Interest centered on heritability of egg shapes, correlation of egg shape with egg wt., and a study of the genetic structure as a whole in relation to environment. In addition to heritability estimates, the analysis provided evidence for sex linkage and for differences between inbred and crossed lines.—*A. W. Kimball.* (Biological Abstracts)

PHYSIOLOGY

CHRISTENSEN, HALVOR N., and THOMAS R. RIGGS. (Tufts Coll. Med. Sch., Boston.)
AMINO ACIDS AND PEPTIDES IN THE OVIDUCT OF THE LAYING HEN. *Proc. Soc. Exptl. Biol. and Med. 83:* 697-698. 1953.—The oviduct of the laying hen, either fresh or after incubation in a minced state, is rich in free amino acids, but the bound, dialyzable amino acids extracted by picric acid are largely limited to glutathione or similarly glycine-rich structures.—*Auth. summ.* (Biological Abstracts)

GREELEY, F., and R. K. MEYER. (U. Wisconsin, Madison.)
SEASONAL VARIATION IN TESTIS-STIMULATING ACTIVITY OF MALE PHEASANT PITUITARY GLANDS. *Auk 70:* 350-358. 1953.—Dried anterior lobes of male and female *Phasianus colchicus* were bio-assayed by injn. into 1-day-old male chicks. Female pituitaries showed less response than those from males. Max. gonadotropic response occurred during the breeding season in April and May, correlated with max. testis wt. of pheasants. A sharp drop in response occurred during June and July, but a significant increase took place during Sept.-Oct. and Nov.-Dec. even though testis wt. was at a minimum during this time. The decline in June indicates that this is the beginning of the refractory period. The level of gonadotropin production in winter is only half the April amt. It is believed that this rate of production accounts for slow development of the testes.—*L. M. Bartlett.* (Biological Abstracts)

HAYS, F. A. (U. Massachusetts, Amherst.)
MORTALITY RATE IN THE LAYING HOUSE AND EGG PRODUCTION OF SURVIVORS. *Poultry Sci. 32:* 1096-1097. 1953.—A total of 400 families of Rhode Island Reds consisting of 4030 surviving daugh-

ters at the end of the 1st laying yr. were examined over a 10-yr. period to detect any possible assoc. between mortality rate in the family and egg production of survivors. Those families giving an avg. egg prod. record above the mean of the flock each yr. were considered to be superior producers while those families falling below the flock mean were considered inferior. Laying house mortality rates were recorded each yr. for families in the 2 categories with respect to egg prod. Appln. of the t test to these data indicated independence between egg prod. of survivors and mortality rate in the laying house.—*F. A. Hays.* (Biological Abstracts)

HSIEH, KUANG-MEI, TUNG-YUE WANG, and HERMAN T. BLUMENTHAL. (St. Louis U. Sch. Med., Missouri.)
THE DIABETOGENIC AND GROWTH-PROMOTING ACTIVITIES OF GROWTH HORMONE (SOMATOTROPIN) IN THE DEVELOPING CHICK EMBRYO. *Endocrinology 51:* 298-301. 1952.—Anterior pituitary growth hormone (somatotropin) exerts a diabetogenic and growth-promoting action when administered during embryonal development of the chick embryo, starting with the 13th incubation day. Female embryos show considerably greater sensitivity to this hormonal stimulus than male embryos. There appears to be no direct correlation between the quantity of hormore injd. and the degree of response, although the most marked avg. response occurred in male embryos receiving 40 μg. of growth hormone, the largest dose used. Growth hormone may also affect hatchability rate; maximal hatchability was obtained with 10 μg. of hormone. The alkalinity of the hormone medium may play a role in diminishing hatchability rate, but large doses of growth hormone may also inhibit hatchability.—*Auth summ.* (Biological Abstracts)

JUHN, MARY. (U. Maryland, College Park.)
A HISTORY OF SIX YEARS' THIOURACIL TREATMENT IN A BROWN LEGHORN HEN. *Jour. Endocrinol. 9:* 155-159. 1953.—A Brown Leghorn hen received 0.5% thiouracil in the diet from 9 weeks of age until the bird was over 6 yrs. old. During this period certain sections of the plumage exhibited a series of new and different pigments, while others remained relatively unchanged. Eggs continued to be laid, but intervals between clutches were greatly lengthened. Tests for fertility by artificial insemination were made at 3 and 6 yrs. of age. Viable chicks were hatched at both times. Dissection of embryos and chicks in the 2d series showed greatly enlarged thyroids.—*A. W. Greenwood.* (Biological Abstracts)

LANDAUER, WALTER. (U. Connecticut, Storrs.)
ABNORMALITY OF DOWN PIGMENTATION ASSOCIATED WITH EXPERIMENTALLY INDUCED SKELETAL DEFECTS OF CHICKS. *Proc. Natl. Acad. Sci. 39:* 54-58. Illus. 1953.—When insulin, boric acid or pilocarpine hydrochloride were injd. into the yolk sacs of eggs of Black Minorca fowl at 96 hrs. of development, they produced skeletal malformations and also changes in down pigmentation which were similar for the 3 compounds. There seemed to be a correlation between extent of skeletal abnormality and degree of restriction in black pigmentation, with slight skeletal defects giving lack of black down only in the extremities, whereas with increased skeletal defects, lack of melanin formation often included the head and neck, all of the wings and large areas of the legs. Embryos and chicks which received protective supplements, remained free of skeletal defects after treatment with insulin, boric acid or pilocarpine and also developed normal pigmentation. Nicotinamide was the most effective protective supplement and confirmed the evidence that disturbances of pigmentation and skeletal defects traced back to common metabolic disturbances. It is suggested that damage to neural crest derivatives may be responsible for the syndrome of skeletal and pigmentary abnormalities.—*Rosalind Morris.* (Biological Abstracts)

LIBBY, D. A., P. J. SCHAIBLE, J. MEITES, and E. P. REINEKE. (Michigan State Coll., East Lansing.)
VALUE OF PROGESTERONE AND ESTRADIOL ON GROWTH AND FINISH IN BROILERS. *Poultry Sci. 32:* 1086-1088. 1953.—Male

and female White Rock chickens were implanted with the 2 female hormones at 7 wks. of age and carried to 11 wks. in growing batteries. Neither hormone, alone or combined, significantly improved the body wts. of either males or females, but there was a slight improvement in all 3 treated groups. Feed conversion was not improved by use of the hormones, singly or in combination. Comb. wts. were reduced by both hormones, but not in an additive manner. However, the combination of hormones was additive in increased liver wts. which were also increased by the hormones singly. Progesterone pellets were less than half absorbed during this trial, whereas estradiol pellets were not recoverable.—*D. A. Libby.* (Biological Abstracts)

MASAHARU, TANGE, HISAYOSHI NISHIYAMA, and YUKIO YAMADA. (Kyushu U., Japan.)

STUDIES ON THE PHYSIOLOGY OF REPRODUCTION IN BIRDS. II. ON THE EFFECTS OF LIGHT ON THE OVULATION IN RING DOVES. [In Japanese with English summ.] *Sci. Bull. Fac. Agric. Kyushu Univ. 12:* 15-26. Illus. 1950.—To study the effects of light on ovulation and egg-laying behavior, ring doves were kept in a dark room (3789 sq. ft.), where, by the use of a time switch, three 100-w electric lamps could be turned on automatically throughout the night and turned off during the day. Ring doves breed successfully in the dark room, adapting themselves to artificial environment; they lay the first eggs of clutch toward the end of daytime of the room, and the 2nd clutch in the beginning of the daytime period 2 days later. The time interval required for the adaption was more than 3 but less than 7 days. A relationship exists between light and ovulation. When ring doves are transferred from normal cages to those in the dark room 27-34 hrs. before the laying of the 1st eggs of the clutch, the dark room being dark, the 2d ovulation of the clutch is delayed presumably more than 10 hrs., and the 2d egg-laying occurrs 50-75 hrs. after the 1st egg-laying. This delay in ovulation of the 2d ovum of the clutch in such situations is discussed in relationship to hormones of the anterior and posterior lobes of the pituitary as well as to progesterone.—*From auth. summ.* (Biological Abstracts)

MUSIL, F. (Czechoslovakia.)

THE CRITICAL STAGES DURING INCUBATION. [KRITICKA STADIA PRI LIHNUTI.] *Drubeznitvi, I, 2:* 26-27, 1953.—The division of incubation period in three critical stages when chicken embryos are dying off. The first critical stage of development is between 4-6 days of incubation and the reason of the death is the high or low temperature or delayed development of allantois. The second critical stage is between 13-15 days of incubation and the reason of the death is usually the overheating of the eggs. The third critical stage is between the 17-19 days and the reason of the death is the disorder at the change of respiration by allontois and by lungs or a consequence of inadequate turning of eggs during incubation.—*V. Orel.*

NISHIYAMA, HISAYOSHI.

STUDIES ON THE PHYSIOLOGY OF REPRODUCTION IN THE MALE FOWL. I. ON THE ACCESSORY ORGANS OF THE PHALLUS. [In Japanese with English summ.] *Sci. Bull. Fac. Agric. Kyushu Univ. 12:* 27-36. Illus. 1953.—The rudimentary copulatory organ (phallus) consists of a clitoris (Masui's "white body", 1925) and a pair of labia minora (the "round folds" of Masui et al.). It has been descr. by many authors. The "Gefässreicher Körper" (Liebe, 1914), which is the accessory organ of the penis in the drake, is poorly known. The relation between the "Gefässreicher Körper" as well as the "Lymphbildungsraum" and the phallus is identical with the relation between those and the penis in the drake, and in the fowl these organs are connected by lymphatic sinuses, so that both organs are considered to be accessory organs of the phallus. In the "second fold" (Masui et al.) of the cloaca are 2 triangular or spindle-shaped folds which lie on the outside of the "round folds" (Masui et al.), one on each. These latter are the labia minora (Hasimoto, 1930); they measure about 2.8 x 1.2 mm. The triangular or spindle-shaped folds are named "lymph-folds" by the present

writer. The lymph-fold consists of simple columnar epithelium and loose connective tissue. Many lymphatic sinuses are found in the connective tissue, and the sinuses communicate with lymphatic sinuses in the phallus as well as with those in the portion which connects the "Gefässreichern Körper" with the phallus. Thus, these organs belong to one and the same system with the phallus as well as the "Gefässreichern Körper" so that the lymph-fold may be considered an accessory organ of the phallus. In the 3-month-old cockerel, the "Gefässreicher Körper" is a light pink colored body, 8 mg. in wt. During the growth period of the bird, the "Gefässreichern Körper" gradually increases in wt., finally reaching about 27 mg.; and shade of color is also intensified, becoming red in the adult cock. The "Gefässreicher Körper", a lymphoid tissue, contains many capillaries filled with blood cells. In the capon, all of the "Gefässreichem Körper," the phallus, and the lymph-folds degenerate. Although the "Gefässreicher Körper," phallus and lymph-folds degenerate in capons, the lymph communication existing in these 3 tissues or organs still remains to the extent that the phallus remains. M. retractor penis posterior and M. retractor penis anterior which have been considered as the muscles taking part in coitus in the drake, have a similar arrangement in the cock.—*Auth. summ.* (Biological Abstracts)

NISHIYAMA, HISAYOSHI.

ON THE DIFFERENCES OF THE FORMS OF PHALLUS IN THE ADULT COCK. [In Japanese with English summ.] *Sci. Bul. Fac. Agric. Kyushu Univ. 12:* 47-50. Illus. 1950.—There are various differences among individuals in the forms of round folds, and they may be divided into 3 types as follows: (1) those lengthened laterally on both right and left sides of the white body, (2) those somewhat lengthened longitudinally on both right and left sides of the white body, (3) those of similar forms to the folds descr. in (2) above, and having, in addition, small folds attached laterally as accessory tissue to each of the round folds. The accessory small folds form the boundary portion of the phallus along the lymph folds, and most of the tissue of these small folds is similar to that of the lymph fold, with the exception of tissue adjacent to the phallus which is the same as phallus-tissue. Because of these morphological differences the forms of the erected phallus are not always identical. The round folds (1) and (2) become heart-shaped, and those of (3) become large without changing their original form.—*Auth. summ.* (Biological Abstracts)

NISHIYAMA, HISAYOSHI.

STUDIES ON THE PHYSIOLOGY OF REPRODUCTION IN THE MALE FOWL. II. ON THE ERECTION OF THE RUDIMENTARY COPULATORY ORGAN (SO-CALLED PHALLUS). [In Japanese with English summ.] *Sci. Bull. Fac. Agric. Kyushu Univ. 12:* 37-46. 1950.—The erection of the rudimentary copulatory organ or phallus of the cock is brought by a cause similar to the erection of the penis in the drake. The lymph, which is copiously secreted in the tissue of the "Gefässreichem Körper," fills up the "Lymphbildungsraum" and then runs off from its hind opening into the phallus through the lymph sinuses. Lymph pressure in the phallus increases greatly, and thus erection is effected. Lymph in the phallus runs off, in a short time, e.g., a few seconds, through the same passage, flowing backwards to the "Gefässreichem Körper." Finally it runs into the lymph duct lying along the A. pudenda interna, whereupon the phallus regains its original quiescent condition. So far as the cock responds to sexual impulses caused by abdominal manipulation the phallus erects every time; some birds continue erections 6 times or more. The most conspicuously swelling portions in the phallus are the labia minora (so called round-folds), especially their anterior parts. Thus the phallus thrusts out back-and downwards, covering the ventral wall of the cloaca. This exposition of the phallus is helped by the relaxation of M. retractor penis posterior and by the swelling of the lymphfolds. In the erect state both sides of the labia minora are in contact with each other, forming the longitudinal groove on the contact portion, roughly heart-shaped. The clitoris lies on its lowest portion. During ejaculation, the papillae approach the swelled round-folds, and the semen is ejected in front of the outer portion of the round-folds.

It flows along both the right and the left round-folds, joining at the upper part of the longitudinal groove down which it runs. Erection of the phallus may help mating but the phallus is not necessarily indespensable for coitus. Lymph-folds swell with the lymph which has caused erection of the phallus, therefore they are considered by the writer as accessory organs of the phallus.—*Auth. summ.* (Biological Abstracts)

RAGAB, M. T., and M. A. ASSEM. (Fouad 1st U., Cairo, Egypt.)
EFFECT OF ATMOSPHERIC TEMPERATURE AND DAYLIGHT ON EGG WEIGHT AND YIELD IN FAYOUMI AND BALADI FOWLS. *Poultry Sci. 32:* 1021-1027. Illus. 1953.—Max. egg yield was reached in Dec. and Jan. for both breeds, and the minimum was found in Aug. and Sept. Max. avg. egg wt. was attained in Jan. and Feb., the min. being in July and Aug. Both temp. and length of daylight influenced egg yield. Correlation between mean egg wt. and yearly egg yield was negative for the Baladi (avg. annual egg wt.—36.6 g.), and weakly positive for the Fayoumi (avg. annual egg wt.—41.0 g.).—*H. D. Branion.* (Biological Abstracts)

SAJNER, J. (University of Brno, Czechoslovakia.)
PRISPEVEK K MIKROSKOPICKE SKLADBE VAJECNE SKORAPKY [CONTRIBUTION TO THE MICROSCOPIC STRUCTURE OF EGG SHELL]. *Skripta Medica, facultarium medecinae universitatis Masarykianae, Vol. XXV:* 31-43, 1952.—Descriptions of egg shells incur, since the time of Nathusius Von Konigsborn, a systematically repeated assertion that the egg shell contains pores, namely canals with their own walls, cutting the width of the shell, in considerable density of an average of a hundred pores per square centimeter per shell area. The author studies both cross and diacope grounds of egg shells from the smallest eggs with a thin shell (humming-bird) to largest eggs with a thick shell (ostrich). He found everywhere a constant ratio of the mamillar to the spongious layer, namely 1/2 to 1/3. Nowhere, even with the aid of polarized light, could any such pores be detected. The egg shell is, of course, passable for gases and colour solutions, and in that sense "porous." Some authors erroneously regard the points of chance passage (not directed by any law) of gases and coloured solutions as inlets of pores (canals), not taking the trouble of verifying this assumption microscopically. It is of interest to note that the great Czech microscopist J. E. Purkyne. contradicted the existence of egg shell canals. His assertion, unluckily, was forgotten.

The author is of the opinion, held also by Studnicka, that the cell free egg shell tissue, tectoplasma, stays living, together with other egg teguments, at least until the egg is laid. The life of this tectoplasma is, of course, minimal and only formative effectuating a purposeful structure organization which lifeless matter could never achieve. In egg shell the example is the mamillar structure and the purposeful spongious structure. The study of the egg shell structure and the analysis of the problems of its origin and life have led the author to putting faith to recent assumptions that the organized cell ceases to be the sole living particle of the organism, life having its continuance also in other forms. —*J. Sajner.*

SMYTH, J. ROBERT JR., and ALVAH T. LEIGHTON, JR. (Massachusetts Agric. Expt. Sta., Amherst.)
A STUDY OF CERTAIN FACTORS AFFECTING FERTILITY IN THE TURKEY. *Poultry Sci. 32:* 1004-1013. 1953.—A study was undertaken to detn. whether any relationships exist between frequency of mating (mg.), mg. efficiency, distr. of mg. broodiness, egg production, and environment on apparent infertility in the Jersey Buff turkey. Observations on mating activity were made daily except Sunday from Jan. 29 to June 8, 1952. Two of the factors studied, the frequency with which a hen mated and the proportion of total completed mgs. participated in by a hen, were signif. correlated ($P<0.01$) with apparent infert. The female was observed to be responsible for initiating mgs., whereas successful completion of available mgs. depended on the males. The incidence of broodiness, no. of eggs laid, and environmental temp. did not appear to influence fert. in the population studied. Preferential mg. be-

havior was not observed to exist in the single male mgs. observed. Therefore, much of the apparent infert. in this flock appeared explainable on the basis of low mg. frequency of the females or poor mg. ability or efficiency of the toms. The mean no. of total mgs. for 82 females was 19.35 with a range of 3-47 mgs. The no. of mgs./hen was not related to incidence of broodiness, egg production, or variations in environmental temps. Statistically signif. differences were found between 7 toms in their ability to mate successfully. The mean percent of total mgs. completed by these 7 males was 68.2 with individuals varying from 44.3 to 87.5%. It was found that 27.0% of the total mgs. occurred prior to the onset of egg production. Frequency of mg. was also high during the week after the return of a female from the broody coop. Mgs. during the latter period represented 37.9% of the total. Therefore, broodiness did affect the distr. of mgs., although it had no appreciable effect on the total no. of mgs. in the population studied.—*J. R. Smyth, Jr.* (Biological Abstracts)

NUTRITION

ACKERSON, C. W., and F. E. MUSSEHL. (U. Nebraska, Lincoln.)
THE UTILIZATION OF FOOD ELEMENTS BY GROWING POULTS. 2. A COMPARISON OF DIETS CONTAINING 25 AND 30 PERCENT PROTEIN. *Poultry Sci. 32:* 958-960. 1953.—Two lots of day-old "Beltsville White" poults were individually fed equal amts. of rations containing 24 and 30% protein. The lot fed the diet with 30% protein showed a greater gain in a shorter period while consuming equal amts. of feed. The percentage utilization of N, Ca, and P was higher in the poults fed the 24% protein ration. The avg. N, Ca and P content of 5-wk.-old poults was 3.3, 0.96 and 0.63%, respectively.—*C. W. Ackerson.* (Biological Abstracts)

BALDINI, JAMES T., ROY E. ROBERTS, and CHARLES M. KIRKPATRICK. (Purdue U., Lafayette, Ind.)
LOW PROTEIN RATIONS FOR THE BOBWHITE QUAIL. *Poultry Sci. 32:* 945-949. 1953.—In each of 3 expts., 2 with 6 lots and 1 with 5 lots of 35-day-old bobwhite quail chicks, the chicks were reared to 6 wks. of age in battery brooders. In the 1st 2 expts. the basal all-mash corn-soybean oil meal ration was supplemented with minerals, vits., and methionine. In 1 expt. 1 lot received a 28% protein ration (prot. ra.) and 5 lots of a 20% prot. ra. For 4 of these lots the 20% prot. ra. was supplemented with either arginine, lysine (lys.), cystine, or threonine. The addition of 0.3% of L-lys. to the 20% prot. ra. produced growth and livability equal to those on the 28% prot. ra.; or 0.3% of lys. replaced 8% of crude prot. None of the other 3 amino acids had any supplemental effect. In 1 expt., rations with 20, 24, or 28% prot. were fed to 2 lots. For 1 lot on each prot. level, 10% of wheat bran replaced an equivalent amt. of corn and soybean oil meal on a prot. basis. Wheat bran resulted in an improvement when included at the 20% prot. level. The action of wheat bran seems best explained on the basis of the increased lys. content of the diet due to its use. In the 3d expt., with rations containing a variety of feedstuffs, 3 lots received rations containing approx. 25% prot. with 1.3 or 1.4% lys.; 2 lots received 22% prot., 1 with 1.1 and the other with 1.4% lys. The 25% prot. diets gave results equal to those usually obtained on 28% prot. diets. Neither of the 22% prot. diets gave results equal to those on the 25% prot. diets, but that with the higher level of lys. gave the better results. The lys. requirement of the growing quail is estimated to be 1.3% at prot. levels of 20 to 24%.—*R. E. Roberts.* (Biological Abstracts)

BRAY, DONALD J., PAUL E. SANFORD, and ROBERT E. CLEGG. (Kansas State Coll., Manhattan.)
THE VALUE OF PAIRED INDIVIDUAL COMPARISONS IN CHICK GROWTH EXPERIMENTS. *Poultry Sci. 32:* 1094-1095. 1953.—Data support more extensive appln. of paired comparisons in chick growth expts. in instances in which a depletion period is applicable. After receiving a fat-free diet for a depletion period, chicks were paired on the

basis of wt. gain, conformation, and general thriftiness. Statistical analysis of growth of chicks fed various fat supplements showed group tests consistently smaller and less significant t values than paired tests due to variation within groups. This variation overshadowed a rather small, but consistent, response of individuals as evidenced by the t values. Paired comparisons make for more valid results from small lots of chicks fed expensive purified diets.—*D. J. Bray.* (Biological Abstracts)

CARLSON, C. W., D. G. JONES, WM. KOHLMEYER, and A. L. MOXON. (South Dakota Agric. Expt. Sta., College Station.)
THE EFFECTS OF VITAMIN B_{12} AND AUREOMYCIN ON REPRODUCTIVE PERFORMANCE IN TURKEYS. *Poultry Sci. 32:* 934-939. 1953.—Vitamin B_{12} was shown to be required in a turkey breeder diet lacking animal protein sources for max. hatchability of fertile eggs. Poults from hens receiving vit. B_{12} in the diet hatched earlier but were smaller at 1 day of age than poults from hens not receiving vit. B_{12}. Under the conditions of this expt., poults from vit. B_{12} fed hens grew more rapidly than the corresponding controls when a subopt. diet was used. When the protein and riboflavin levels were increased and dried brewer's yeast was added and penicillin rather than Aureomycin (Amcin.) was used in the starter diet, the earlier differences in growth were not obtained. Crystalline Amcin. appeared to cause an increase in egg production, but also may have caused a decrease in hatchability of fertile eggs. Such a detrimental effect was not noted in other work when a feed grade antibiotic and vit. B_{12} supplement was used. Amcin. in the breeder diet appeared also to improve progeny growth on the suboptimal starter diet but not on the altered starter diet.—*C. W. Carlson.* (Biological Abstracts)

CATALAN, MARCELO V. (University of the Philippines, College of Agriculture, College, Laguna, Philippines.)
AUROFAC AS A SUPPLEMENT TO THE COLLEGE GROWING RATION FOR CHICKS. *Philippine Agric. 36:* 295-302. 1952.—The feeding value of the College growing mash was enhanced by the addition of 1/2 per cent level of Aurofac. In all trials, it consistently increased the weight of the chicks, decreased their mortality, and reduced the amount of feed to produce a kilogram gain in weight.—*F. M. Fronda.*

COONEY, W. T., and J. E. PARKER. (Oregon State Coll., Corvallis.)
WOOD SUGAR MOLASSES IN THE RATION OF FLOOR-MANAGED LAYERS. *Poultry Sci. 32:* 1039-1046. 1953.—Three groups of White Leghorn pullets kept on littered floor pens were fed 0, 7.5 and 15% wood sugar molasses (w.s.m.) in the mash portion of the ration for an 11-mo. period. Whole mixed grains amting. to approx. 40% of the total ration were hand fed. The percentages of w.s.m. in the total ration of the 3 pens were 0, 4.4 and 9.1. Pullets fed mash with 7.5% w.s.m. laid 7% more eggs than the controls, whereas those fed 15% w.s.m. mash showed no increase. W.s.m. increased feed consumption. Pullets receiving the lower level produced eggs as efficiently as the controls, but those on the higher level required more feed to produce each dozen eggs. Feed required/doz. eggs was 5.0, 4.9 and 5.6 lbs., resply., for pens fed 0, 7.5 and 15% w.s.m. in the mash. Feeding of w.s.m. had no influence on mortality rate. Eggs from pullets fed the 15% w.s.m. mash did not hatch as well as those from the other 2 pens which hatched at about the same rate. Litter from pens in which w.s.m. was fed contained more moisture and there were more soiled eggs than in the control pen.—*W. T. Cooney.* (Biological Abstracts)

DYMSZA, HENRY, R. V. BOUCHER, and E. W. CALLENBACH. (Pennsylvania State Coll., State College.)
THE INFLUENCE OF ANTIBIOTIC SUPPLEMENTATION ON CERTAIN PHYSICAL AND CHEMICAL CHARACTERISTICS OF TURKEY POULTS. *Poultry Sci. 32:* 989-993. 1953.—Two groups of White Holland poults were fed a diet with and without Terramycin (Termyc.) supplemented at the rate of 10 g./ton. At 4 wks. of age, 25 female poults from each group were selected for analysis. Poults given the supplemented diet were significantly heavier in live and empty wts.,

and the empty intestinal tracts and gizzards were signif. and proportionately heavier. However, when expressed as percent of empty wt., the avg. wts. of intestinal tracts, gizzards, ceca, and alimentary contents of poults in both groups had approx. similar values. Chemical analyses showed that the growth increase attributed to Termyc. had little relation to carcass composition with the possible exception of an increase in dry matter content. The ether extract content was slightly but not signif. higher in carcasses from the Termyc.-fed group. No differences due to treatment were apparent in carcass protein or ash content. The overall effect of antibiotic supplementation appeared to be the production of larger poults of normal composition.—*Auth. summ.* (Biological Abstracts)

FELL, R. V., and E. L. STEPHENSON. (U. Arkansas, Fayetteville.)
THE EFFECT OF PENICILLIN AND PENICILLAMINE ON CHICK GROWTH WHEN INJECTED AND WHEN FED ORALLY. *Poultry Sci. 32:* 1092-1093. 1953.—In White Wyandotte chicks fed an all vegetable diet, the injn. of penicillamine resulted in a greater and more consistent growth response than did injn. of penicillin or the feeding of penicillin or penicillamine orally. Injd. materials were admd. at levels of 0.05 and 1. mg./day, whereas the materials fed orally were fed at the rate of 1 mg./lb. of feed.—*E. L. Stephenson.* (Biological Abstracts)

GANGULY, J., J. W. MEHL, and H. J. DEUEL, JR. (U. Southern California, Los Angeles.)
STUDIES ON CAROTENOID METABOLISM. XII. THE EFFECT OF DIETARY CAROTENOIDS ON THE CAROTENOID DISTRIBUTION IN THE TISSUES OF CHICKENS. *Jour. Nutrition 50:* 73-83. 1953.—Lutein in high concns., and beta-carotene in traces, were present in the tissues and egg yolks of hens on a farm diet. When these animals were placed on low-carotenoid or carotenoid-free diets, the carotenoid concns. in the tissues were very low. Such hens still produced eggs, though irregularly. Day-old baby chicks were brought to maturity and subsequently laid eggs when maintained on a carotenoid-free diet. When pure carotenols, such as cryptoxanthin, were given orally to such carotenoid-depleted animals, high concns. of these pigments could be found in their tissues. On the other hand, when pure hydrocarbon carotenoids, such as alpha-carotene, beta-carotene or lycopene, were admn. orally, only traces of these latter compounds were present in their tissues. In contrast to oral admn., when colloidal suspensions of carotenoids including carotenols were introduced intraven. into such birds, none of these could be found in the blood, though considerable amts. were deposited in the liver. Carotenoids apparently are not required for growth or egg production in the chicken, and in contrast to hydrocarbon carotenoids, carotenols are able to pass the intestinal wall and appear in plasma and other tissues of the chicken.—*Auth, (courtesy Wistar Bibl. Serv.)*

GILLIS, M. B., L. C. NORRIS, and G. F. HEUSER. (Cornell U., Ithaca, N.Y.)
PHOSPHORUS METABOLISM AND REQUIREMENTS OF HENS. *Poultry Sci. 32:* 977-984. 1953.—Experiments have shown that phytin P is not as satisfactory as inorganic P in meeting the requirements of laying hens. This was found to be true of both purified Ca phytate and the phytin found in common feedstuffs of plant origin. It was estimated that the hens in these expts. utilized phytin P approx. 50% as effectively as they utilized defluorinated phosphate or dicalcium phosphate. It apeared that 0.5% of inorganic or "available" P was required for egg production and maintenance of wt. For the maintenance of opt. blood P and the prevention of decalcification of bone, however, the requirement was apprx. 0.6%.—*M. B. Gillis.* (Biological Abstracts)

HALICK, J. V., B. L. REID, C. L. BROWN, and J. R. COUCH. (Texas Agric. Expt. Sta., College Station.)
THE VITAMIN B_{12} CONTENT OF EGG YOLKS AS INFLUENCED BY ORAL AND PARENTERAL ADMINISTRATION OF THE VITAMIN. *Jour. Nutrition 50:* 331-340. 1953.—The effect of feed-

ing a surface-active agent on the hatchability and B_{12} content of egg yolks was studied. Marked increases in the B_{12} content of egg yolks were obtained by the injn. of high levels of the vit. into the hen as compared with the amts. in eggs from hens where the vit. was fed. These differences indicate that there is limited absorption or possible destruction of vit. B_{12}, or both, in the intestinal tract when it is ingested orally. The presence of a surface-active agent and a high level of B_{12} in the ration resulted in an increase in the B_{12} content of the egg yolks over that in the yolks from hens fed the high level of B_{12} alone. These results suggest that absorption of the vit. was enhanced by the presence of the surfactant. There was no apparent increase in the B_{12} content of eggs from hens fed the surfactant with a lower level of B_{12}. Under the conditions of this expt. the high level of B_{12} observed in the eggs had no deleterious effects on hatchability. Similarly, the hatchability of eggs from hens fed the surfactant, with and without B_{12} was normal.—*Auth. (courtesy Wistar Bibl. Serv.).*

LAGMAN, ALFONSO M. (University of the Philippines, College of Agriculture, College, Laguna, Philippines.)
ANIMAL PROTEIN FACTOR AS A SUPPLEMENT TO A GROWING RATION FOR CHICKS WITH ROASTED MUNGO MEAL AS THE PRINCIPAL INGREDIENT. *Philippine Agric. 36:* 210-217. 1952.—Chicks that were given an all-vegetable ration with roasted mungo meal as the principal protein ingredient and supplemented with animal protein factor were heavier than those given an unsupplemented ration, but in spite of their weight, the chicks had poor growth. Mortality was much higher in the control lot, and the feathering, pigmentation, and beak, comb, and wattle development of the birds were subnormal. The chicks in the supplemented lot were normal in all respects. Although the animal protein factor improved the ration, the improvement was too inadequate to justify the use of the ration.—*F. M. Fronda.*

McGINNIS, JAMES, and JOEL R. STERN. (State Coll. Washington, Pullman.)
EFFECT OF THE FEED PELLETING PROCESS ON GROWTH RESPONSE OF POULTS TO ANTIBIOTIC SUPPLEMENTS. *Poultry Sci. 32:* 1036-1038. 1953.—Two expts. were conducted with turkey poults to detn. the effect of the feed pelleting operation on stability of procaine penicillin (proc. pen.), diamine penicillin (diam. pen.), and Aureomycin (Amcin.). In the 1st trial pharmaceutical antibiotics (antib.) were used; in the 2d trial antib. food supplements obtained on the open market were added. In each trial graded levels of 1, 2, and 5 ppm. of the pens. and 2, 5, and 10 ppm. of Amcin. were added to the feed. One series of diets was pelleted (pelld.) after addition of antib.; in the 2d series the basal diet was pelld before the addition of antib. Results based on growth response of poults, showed that the antib. tested were stable to the feed pelling. operation. A 1-ppm. level of procaine or diam. pen. added to the feed before pelling, was as effective in promoting growth as this level added after the feed was pelld. Also, this level gave poult growth comparable to levels of 2 and 5 ppm. The pens, were more effective than Amcin. in promoting poult growing.—*James McGinnis.* (Biological Abstracts)

NORDSKOG, A. W., and ELTON L. JOHNSON. (Iowa State Coll., Ames.)
BREED DIFFERENCES IN RESPONSE TO FEEDING ANTIBIOTICS. *Poultry Sci. 32:* 1046-1051. 1953.—Twelve pens of chicks having 9 kinds of breeding (inbreds, outbreds, crossbreds, and top-crosses of both Mediterranean and general purpose breeds) were fed rations with and without antibiotics (antib.) (penicillin and Aureomycin) to 8 wks. of age. The total no. of chicks in 3 hatches was 2454. Chicks fed the antib. rations gained an avg. of 12.7% more than the controls. The gain for the different breed groups varied from 6.3 to 22.6%. The differential response of the breed groups to antib. was found to be highly significant statistically. Increased livability resulted from feeding antib. In pens of chicks on the control ration the avg. mortality was 9.1% while in those on the antib. rations the avg. was 3.7%. This difference was

highly signif. The differential response of antib. on livability was not statistically signif.—*A. W. Nordskog.* (Biological Abstracts)

PATRICK HOMER. (U. Tennessee, Knoxville.)
THE EFFECT OF PROCESSING METHOD AND CERTAIN SUPPLEMENTS ON A LYSINE DEFICIENCY IN COTTONSEED MEAL FOR CHICKS. *Poultry Sci. 32:* 942-944. 1953.—The magnitude of lysine (lys.) deficiency in a cottonseed (c.s.) meal ration for chicks is influenced by the method of manufacturing c.s. meal. The lys. in hydraulic meals is less available to chicks than unheated solvent meals. C.s. meals are deficient in vit. B_{12} and if properly manufactured have only a borderline deficiency of lys. The addition of either penicillin or Aureomycin to different c.s. meal rations for chicks resulted in increased growth rate. Although lys. increased the growth rate and improved pigmentation of the feathers, the feathers did not appear as well pigmented as those in chicks receiving soybean oil meal or casein. C.s. meal is deficient in a factor other than lys.—*H. Patrick.* (Biological Abstracts)

PEPPER, W. F., S. J. SLINGER, and E. S. SNYDER. (Ontario Agric. Coll., Guelph, Canada.)
VALUE OF LOW LEVELS OF SOYBEAN OIL IN BROILER DIETS CONTAINING A HIGH PERCENTAGE OF WHEAT. *Poultry Sci. 32:* 1084-1085. 1953.—Broiler diets made up mainly of wheat and soybean oil meal were improved by supplementation with 1 or 2% soybean oil. The wt. increases in females were highly significant and the market finish was considerably improved. In males the wt. increases were not signif. and there was apparently no improvement in finish. —*S. J. Slinger.* (Biological Abstracts)

PRICE, WILLIAM A. JR., M. WIGHT TAYLOR, and WALTER C. RUSSELL. (Rutgers U., New Brunswick, N. J.)
THE RETENTION OF ESSENTIAL AMINO ACIDS BY THE GROWING CHICK. *Jour. Nutrition 51:* 413-422. 1953.—The percentage retentions and excretions of essential amino acids were detd. when growing chicks were fed a standard chick starter mash (A) containing 21.9% protein largely from plant sources, and a ration (B) containing 16.3% protein largely from animal sources. On ration A, 24 to 43% of the essential amino acids consumed was retained in the body 11 to 21% was excreted and 36 to 58% was unaccounted for and considered to have been catabolized. Corresponding values for ration B were 39 to 71%, 9 to 15%, and 20 to 51%, demonstrating a more efficient utilization of essential amino acids on the lower protein level. The protein level of the diet had relatively little effect on total N, 56% retained, 38% excreted and 6% unaccounted for. There was a marked similarity in the patterns of essential amino acids in the 2 rations and in the chicks' bodies.—*Auth. (courtesy Wistar Bibl. Serv.).*

SQUIBB, ROBERT L., MIGUEL GUZMAN, and NEVIN S. SCRIMSHAW. (Inst. Nutricion Centro-América y Panamá, Guatemala.)
EFFECT OF PASTURE, DEHYDRATED RAMIE MEAL, AND SEX ON FIVE BLOOD CONSTITUENTS OF NEW HAMPSHIRE CHICKENS IN GUATEMALA. *Poultry Sci. 32:* 953-957. 1953.—In Guatemala, pasture of kikuyu grass maintained in New Hampshire hens high blood-serum levels of total carotenoids, vit. A, and riboflavin but did not affect levels of protein and ascorbic acid. Ramie meal, added to laying mash, raised levels of carotenoids and vit. A but not of protein and ascorbic acid. Hens had higher riboflavin levels than roosters of the same age, and laying hens had higher levels than did pullets.—*Theodora Carlson.* (Biological Abstracts)

SQUIBB, ROBERT L., MIGUEL GUZMAN, and NEVIN S. SCRIMSHAW. (Inst. Nutricion Centro-América y Panamá, Guatemala.)
DEHYDRATED DESMODIUM, KIKUYU GRASS, RAMIE, AND BANANA LEAF FORAGES AS SUPPLEMENTS OF PROTEIN, RIBOFLAVIN, AND CAROTENOIDS IN CHICK RATIONS. *Poultry Sci. 32:* 1078-1083. 1953.—Four forage meals, all with a chemical content making them equal or superior to alfalfa meal, are excellent supple-

ments of proteins, riboflavin, and vit. A activity in baby chick rations in Guatemala. They also maintain high blood-serum levels of riboflavin, ascorbic acid, carotenoids, and vit. A.—*Theodora Carlson.* (Biological Abstracts)

STOKSTAD, E. L. R., T. H. JUKES, and W. L. WILLIAMS. (Lederle Labs. Div., Amer. Cyanamid Co., Pearl River, N. Y.)
THE GROWTH-PROMOTING EFFECT OF AUREOMYCIN ON VARIOUS TYPES OF DIET. *Poultry Sci. 32:* 1054-1058. 1953.—The growth response of chicks to Aureomycin (Amcin.) was greatest on a diet containing sucrose (suc.) and least on one containing starch. The time of food passage through the intest. tract was less on the suc. diet than on starch or glucose diets. Addition of amcin, increased the food passage time on the suc. diet but had no effect on the other 2 types of diets. Growth responses to both yeast and amcin. were obtained on diets containing approx. 20% protein. The response to Amcin. was not modified by the presence of yeast and the effect of the 2 together was only slightly less than the sum of the individual responses.—*E. L. R. Stokstad.* (Biological Abstracts)

TITUS, HARRY W., ARNON L. MEHRING, JR., and JOHN H. BRUMBAUGH.
VARIATION OF FEED CONVERSION. *Poultry Sci. 32:* 1074-1077. 1953.—The standard deviation of the feed conversion (feed per unit wt. of gain) of small lots of chicks (17-20 chicks/lot), to the age of 10 wks., was estimated to be 0.1. When single lots of chicks are compared, the difference (diff.) in feed conv. must be at least 0.28 lb. of feed/lb. of gain to be significant at the 5% point (odds, 19-1). To demonstrate that a diff. of 0.1 lb. of feed/lb. of gain is signif. (odds, 19-1), duplicate lots of chicks containing at least 80 chicks/lot would be required in a typical comparison. A table of min. signif. diffs. in feed conv. is given for single, duplicate, triplicate, and quadruplicate lots (about 20 chicks/lot).—*H. W. Titus.* (Biological Abstracts)

WHARTON, F. D. JR., and J. C. FRITZ. (Dawe's Lab., Inc., Chicago.)
STUDIES ON THE EFFECT OF AN ARSENICAL IN THE DIET OF THE IMMATURE AND MATURE CHICKEN. *Poultry Sci. 32:* 1014-1020. 1953.—Para-hydroxy phenylarsonic acid (PHP). was fed to New Hampshire chicks at a level of 45.4 g./ton of feed, from hatching through 7 mos. of egg production. There were no differences in age at production of 1st egg, production of fertile eggs, hatchability, wt. of chicks at hatching, or growth response of progeny fed diets containing an antibiotic, no antib., or no antib. and PHP, 45.4 g./ton. There was a significant difference in the manner in which egg wt. of the arsenical-fed birds reached their max.—*F. D. Wharton, Jr.* (Biological Abstracts)

WILCOX, R. A., C. W. CARLSON, WM. KOHLMEYER, and G. F. GASTLER. (South Dakota Agric. Expt. Sta., College Station.)
CALCIUM AND PHOSPHORUS REQUIREMENTS OF POULTS FED PURIFIED DIETS. *Poultry Sci. 32:* 1030-1035. 1953.—A purified diet using beef blood fibrin and gelatin as sources of protein and almost devoid of Ca and P was supplemented with Ca levels of tech. $CaHPO_4$ and $CaCO_3$ and fed to BSW poults from hatching to 4 wks. of age. The purified diet required additions of dried buttermilk (2%) and forage juice (1%) to equal a practical diet in terms of final body wt. and AOAC bone ash. Max. bone ash was obtained with diet levels of 0.8% P and 1.5% Ca.; however, max. body wt. required levels of 1% P and 2% Ca.—*R. A. Wilcox.* (Biological Abstracts)

YACOWITZ, H., and O. D. BIRD. (Parke, Davis and Co., Detroit, Michigan.)
ANTIBIOTIC LEVELS IN THE DIGESTIVE TRACT OF THE CHICK. *Poultry Sci. 32:* 966-968. 1953.—Leghorn cockerels were each given a single oral dose of crystalline antibiotic and 4 hrs. later various segments of the digestive tract were removed and assayed for antib. content. Terramycin HCl was present at the highest concn. while Aureomycin HCl and procaine penicillin G were present at intermediate concns.

Chloromycetin was present at the lowest concn. especially in the small intestine and ceca. The very low concn. of chloromycetin in the gastrointestinal tract indicates rapid absorption and may account for failure to obtain chick growth responses with this antib.—*Authors.* (Biological Abstracts)

YOUNG, R. J., M. B. GILLIS, and L. C. NORRIS. (Cornell U., Ithaca, N.Y.) AN UNIDENTIFIED FACTOR IN PEANUT MEAL REQUIRED BY THE CHICK. *Jour. Nutrition 50:* 291-297. 1953.—Repeated expts. with cross-bred male chicks (R.I.R.xB.P.R.) fed a purified diet composed largely of cornstarch and purified casein (25%) plus methionine and glycine, failed to show opt. growth when the birds were given graded levels of arginine up to 2.06%. The addition of 5, 10, or 15% alcohol-extracted peanut meal, replacing equivalent amts. of casein protein, promoted a marked growth response over that obtained on the basal diet supplemented with levels of arginine equal to those supplied by the peanut meal. The growth response was not due to a change in amino acid composition of the diet. The casein and peanut meal were assayed microbiologically for the essential amino acids, except glycine. Glycine and methionine plus cystine were kept constant in all diets regardless of the level of peanut meal supplied. The percentage of the other essential amino acids decreased slightly as the amt. of peanut meal was increased. Under the conditions of these expts. alcohol-extracted peanut meal supplied an unknown factor needed for chick growth, which was lacking in a purified casein diet. The results indicate that the chick's requirement for arginine is approx. 1.38% of a diet containing 23% protein. This confirms the results of previous workers, who found the arginine requirement to be 6% of the dietary protein.—*Auth. (courtesy Wistar Bibl. Serv.)*

PATHOLOGY

KLIMES, B. (Czechoslovakia.) THE INFLUENCE OF DDT UPON THE POULTRY AND PHEASANTS. [VLIV DDT NA SLEPICE A BAZANTY.] *Sbornik-vysoké skoly zemedelske v Brne, Spisy fak. vet. XXII, 1:* 35-38. 1953.—For hens 2.1 g. of DDT and for pheasants 1.6 g. for 1 kg. of live weight were not detrimental, but 3.12 g. for hens and 4.4 g. for pheasants were harmful. Repeating the doses of 0.2 g. during 14 days were not detrimental but after 0.33 g. hens died as well as pheasants. The author gives the clinical symptoms of the poisoned animals. In normal agricultural conditions according to these results there is no danger of poisoning the poultry by DDT. *(V. Orel)*

KLIMES, B. (Czechoslovakia.) THE INFLUENCE OF INFRA-RED LAMP HEATING UPON THE OCCURRENCE OF COCCIDIOSIS. [VLIV INFRACERVENYCH LAMP NA KOKCIDIOSU KURAT.] *Drubeznictvi, I. 3:* 47-48. 1953.—Experiments were done for studying the influence of infra-red lamp heating upon the livability of oocysts of coccidiosis. The oocysts to the distance of 50 cm from the lamp were dead in 16 hours and at the distance of 90 cm in 36 hours. It may be said that at these distances the oocysts are destroyed sooner as they may be a source of infection. *(V. Orel.)*

POULTRY PRODUCTS AND MARKETING

GAZDA, J. (Czechoslovakia) THE SLAUGHTERING LINE FOR THE POULTRY. [MECHANICKE OPRACOVANI HRABAVE DRUBEZE NA PASU.] *Prumysl potravin, IV, 5:* 211-213. 1953.—The description of a slaughtering line, the electrical arrangement for the stunning, the scalding in water at the temperature of 50-59°C., the plucking machines, squeezing of the excrements from cloaca, washing and packing of slaughtered poultry.—*(V. Orel)*

HATHAWAY, H. E., G. B. CHAMPAGNE, A. B. WATTS, and C. W. UPP. (Louisiana State U., Baton Rouge.)

MEAT YIELD OF BROILERS OF DIFFERENT BREEDS, STRAINS, AND CROSSES. *Poultry Sci. 32:* 968-977. 1953.—To test actual meat yield of several breeds, strains, and crosses, 3 trials with 12-wk. old broilers of 7 different breeds, strains, and crosses were killed, measured, processed, and boned for observation. These consisted of Dark Cornish, 3 strains of New Hampshires, White Plymouth Rocks, and 2 crossbred stocks. Ten males and 10 females from each lot were selected at 12-wks. of age, starved overnight, killed by the "sticking and debraining" method, and semi-scalded at 128°F. for 30 sec. Feathers were removed and Carcasses chilled overnight at 40°F. Individual keel length, body depth, and breast width were measured with a vernier caliper. Eviscerated wts. were obtained; edible meat was then removed from the bones with a sharp knife. Breast muscles were first removed; the legs were then disjointed and meat was removed from the thigh and drumstick as 1 operation. All edible meat was removed as completely as possible except from the neck and the outer 2 joints of the wing. Giblets were not considered in any of the edible meat wts. The Dark Cornish yielded a higher percentage of edible meat in each trial than any other lot, (36.4%) on the basis of both live and eviscerated wt. Birds from a broiler strain of New Hampshires tended to yield the lowest, (28.3%). Real differences in percentage meat yields existed in different stocks and these differences were found to be significant statistically. Body measurements made on individual birds indicate that breast width is the best single measure for predicting percentage total edible and breast yield in 12-wk. old chickens.—*Authors.* (Biological Abstracts)

JEFFREY, FRED P. (U. Massachusetts, Amherst.)

CAPONS VERSUS TURKEY BROILERS. *World's Poultry Sci. Jour. 9:* 266. 1953.—Production data, cost and income factors are tabulated for Beltsville, White Holland, and B.B. Bronze turkey broilers versus capons. Feed conversion of 5.3 lbs. for 26-wk. old capons compared with 3 to 3.9 lbs. for 12-17 wk. old turkey broilers.—*J. B. Christiansen.* (Biological Abstracts)

LOPEZ, RAUL L. (University of the Philippines, College of Agriculture, College, Laguna, Philippines.)

GROWTH AND DRESSING EFFICIENCY OF SEXED SINGLE COMB WHITE LEGHORN AND NEW HAMPSHIRE MALE CHICKS RAISED AS BROILERS. *Philippine Agric. 36:* 263-269. 1952.— New Hampshires can be more efficiently raised as broilers than S.C. White Leghorns. At 12 weeks, the New Hampshire males averaged 913.9 ± 20.99 grams; the S.C. White Leghorns, only 791.3 ± 19.25 grams. There was not much difference in dressing percentage, being 72.3 in the New Hampshires and 71.4 in the S.C. White Leghorns. The average mortality of the New Hampshire lot was only 5.0 per cent; that of the S.C. White Leghorn lot, 10.0 per cent. The New Hampshires were more efficient converters of feed, requiring only 4.46 kilograms to produce a kilogram gain. The S.C. White Leghorns required 4.99 kilograms.—*F. M. Fronda.*

OREL, V. (Czechoslovakia.)

THE PROBLEM OF SOUR EGGS. [PROBLEM KYSELYCH VAJEC.] *Prumysl potravin, 15, 2:* 86-87. 1953.—After storage of shell eggs in cold storage and in lime water there were in our practice of preservation more sour eggs from lime water than from the cold storage. Analysing the reason of it the author explains that for the preservation the eggs were preserved without candling and also with dirty shells meanwhile for cold storage the eggs were candled and eggs with dirty shells eliminated.—*(V. Orel)*

SAUTER, E. A., J. VIVIAN HARNS, W. J. STADELMAN, and BARBARA A. McLAREN. (Washington State Coll., Pullman.)

RELATIONSHIP OF CANDLED QUALITY OF EGGS TO OTHER QUALITY MEASUREMENTS. *Poultry Sci. 32:* 850-854. 1953. —4600 eggs were used in this study. Approx. half of them were fresh

(day-old) eggs, the remainder being stored from 1 wk. to 6.5 mos. under varying recorded temp. and humidity conditions. Highly significant correlations were obtained between candled quality and albumen index, yolk index, yolk color, albumen score, and pH. There were highly significant correlations between candled quality and angel food cake quality as measured by vol., penetration and panel score; custard quality, as measured by penetration, height and taste panel score; poached egg quality as measured by cooked albumen index and panel score; and taste panel score of eggs cooked in the shell. The higher the quality of the egg as detd, by candling, the better the cooked product.—*W. J. Stadelman.* (Biological Abstracts)

TABLANTE, NATHANIEL B. and CORAZON P. SALAMAT. (University of the Philippines, College of Agriculture, College, Laguna, Philippines.)

CONSUMER PREFERENCES AND RETAIL PURCHASES OF POULTRY AND EGGS OF 300 HOUSEHOLDERS IN NAGA CITY. *Philippine Agric. 36:* 317-321. 1952.—The general preference was for locally produced, fresh, large-sized, white-shelled eggs. Chicken and duck (Mallard) eggs were commonly purchased, but chicken eggs were used by more consumers. The consumers preferred the native breed of chicken and the heavy or large-size female birds. Eighty-seven per cent of the households would rather buy live birds than other forms. Ducks, turkeys, and squabs were not generally purchased. Chickens and eggs were usually purchased from the public market singly once a week or when they were needed. The average weekly consumption of a household with an average of 7.8 members was 11 chicken eggs and eight duck eggs. The average consumption of chickens was four a month.—*F. M. Fronda.*

TABLANTE, NATHANIEL B. and MELCHOR F. CONSTANTINO. (University of the Philippines, College of Agriculture, College, Laguna, Philippines.)

THE MARKETING OF DUCK EGGS IN MORONG, PASIG, AND PATEROS, RIZAL. *Philippine Agric. 36:* 303-309. 1952.—Eggs were marketed daily by 60.2 per cent of the producers; three times a week by 18.8 per cent; twice a week by 18.2 per cent; and weekly by 2.8 per cent. These eggs were sold for cash by producers either to wholesalers or to retailers. On the average, 512 eggs at P14.12 a hundred were sold to Manila retailers at each marketing; 300 to *balut* makers at P13.00; 126 to local buyers at P12.18; and 104 to local retailers at P13.28. Producers would possibly get greater returns from the sale of their products if they had sufficient knowledge of market conditions, avoided competition among themselves, had adequate market facilities, paid more attention to sorting and grading their products, and regulated the production and quantity of eggs marketed to avoid fluctuation in prices.—*F. M. Fronda*

GENERAL

AKPINAR, A. CEMALITTEN. (Zootekni Ens. Ankara, Turkey.)

IMPROVING THE POULTRY INDUSTRY IN TURKEY. *World's Poultry Sci. Jour. 9:* 252-254. 1953.—With an estimated 23 million chickens, turkeys, ducks and geese, Turkey exported 7278 metric tons of eggs in 1952. Poultry improvement plans include importation of breeding stock and use of some suitable native birds for replacement of village poultry. Hatching eggs were imported from England and the U.S. in 1952. Suitable sources of animal protein and an improved export market need to be developed.—*J. B. Christiansen.* (Biological Abstracts)

GERICKE, A. M.

POULTRY FARMING IN SOUTH AFRICA. *Union S. Africa Dept. Agric. Bull. 329.* 1-178. Illus. 1953. Pr. 2s.—Discusses the industry in South Africa, incubation of eggs, rearing of chicks, nutrition, inheritance, poultry diseases, and economic aspects of poultry farming. (Biological Abstracts)

JASPER, A. WILLIAM. (Cornell U., Ithaca, N. Y.)
THE EXTENT OF SPECIALIZED POULTRY AND EGG MARKETING INSTRUCTION IN OUR STATE COLLEGES. *Poultry Sci. 32:* 1028-1030. 1953.—State colleges offer 52 courses in specialized egg and poultry marketing instruction: 46 are given by poultry departments, 6 by agricultural economics departments. Only 5 of 48 state colleges offer no specialized courses in egg and poultry marketing. It is recommended that students of egg and poultry marketing be trained in poultry science and agricultural economics.—*A. W. Jasper.* (Biological Abstracts)

KALINA, R. (Czechoslovakia.)
OUR PRACTICE WITH THE DUCK INDUSTRY IN OUR COUNTRY. [NASE ZKUSENOSTI S VELKOCHOVY KACHEN]. *Drubeznictvi, I, 9:* 164-66. 1953.—The conditions for profitable duck meat production, the rearing of ducks, the building of duck houses and the principal of feeding technic considering especially the deficiency of vit. A and of B group. Advantage of calling the ducks to the feeding by the piping signal. The prevention of infectious diseases.—*(V. Orel)*

LAIRD, PATRICK R.
THE PLACE OF POULTRY IN SCOTTISH FARMING. *World's Poultry Sci. Jour. 9:* 247-251. 1953.—Scotland has 32,000 full-time farms and 26,000 smaller units larger than 1 acre. Eggs and poultry provide 12.3% of the gross farm income. Only 5.5% of the poultry is raised on specialized farms. Historical development is outlined.—*J. B. Christiansen.* (Biological Abstracts)

(ERRATA—In the January-March, 1954 issue of the World's Poultry Science Journal on page 63 and on page 77—AGCANOS, PABLO B. should read AGCANAS, PABLO R.)

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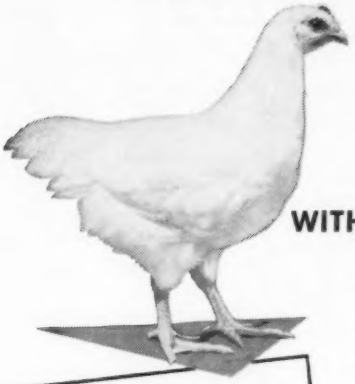

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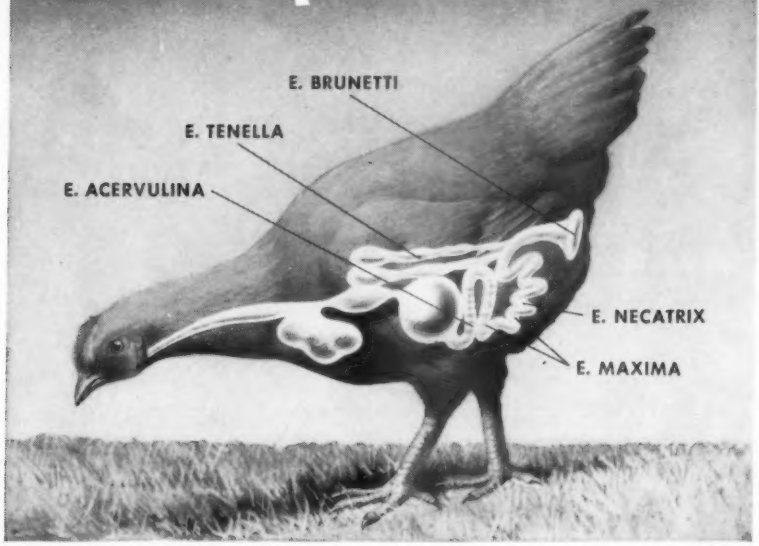

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